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THE JOURNAL

OF THE

ROYAL AGRICULTURAL SOCIETY OF ENGLAND

THE RE-ORGANIZATION OF MARKETING IN NORTHERN IRELAND.

The question of the improved marketing of Northern Ireland agricultural produce has received the constant attention of the Northern Ireland Ministry of Agriculture since its inception, and a long series of legislative enactments dealing with marketing has been passed by Parliament. This body of legislation falls into two parts. During the years from 1922 to 1932 a series of Acts was passed dealing with the standards of quality to be complied with by farmers selling agricultural products, and also by wholesale dealers engaged in trading in the various agricultural products dealt with by legislation. This early legislation was concerned primarily with improving the quality of the produce marketed by controlling the methods of sale, of grading, and of packing adopted by the farmer or the wholesaler. During the period since 1932 legislation has been more particularly concerned with the actual methods of marketing, with the re-organization of the channels through which agricultural produce passes from the farmer to the consumer, with the elimination of unnecessary and redundant intermediaries, and with the limitation of the margin enjoyed by those who process, or trade in, agricultural products where this margin has been found to be excessive. Even in this later legislation, however, considerations of quality have seldom been absent and, as will be seen, it has been a cardinal feature of recent agricultural legislation in Northern Ireland to secure that wherever possible agricultural products are sold to the consumer on a quality basis.

One of the great advantages enjoyed by the agricultural industry in Northern Ireland through the creation of a separate

Parliament in 1921 has been the greater ease with which parliamentary time has been found for the consideration of agricultural subjects. In a country where almost one-half of the population resides in rural areas, and with a Parliament of 52 members of whom 27 represent predominantly rural constituencies, this interest in agricultural questions will be readily appreciated. As a consequence, parliamentary time has seldom been lacking for the introduction and consideration of agricultural measures, and it has been possible to tackle the reform of agricultural marketing methods by stages. It has seldom been necessary to proceed by means of a single comprehensive enabling enactment, and gradual improvement has been effected by successive Acts of Parliament each of which has been limited and precise in its scope but has opened the door for the introduction of further reforms at a later date. This progressive and *ad hoc* character of Northern Ireland legislation may be well illustrated from the Marketing of Eggs Acts passed between 1924 and 1936.

The Marketing of Eggs Act of 1924, which was the first enactment dealing with marketing passed by the legislature in Northern Ireland, provided for the licensing of all wholesale dealers in eggs, and for giving the Ministry of Agriculture power to prescribe the grades and style of packages in which wholesale dealers should sell eggs. The fee for a licence was one pound and the licence remained in force indefinitely unless it was revoked for non-compliance with the prescribed conditions attaching to it. Nevertheless, the effect of the Act of 1924 was outstanding in the highest degree. It ensured that all Northern Ireland eggs sold by wholesale should be sold in accordance with specified weight grades in standard cases, and that all eggs included in these grades should have been tested for freshness by the daylight tester, or "candled," to use the expression which is probably most familiar in Great Britain. The Act of 1924 resulted in a widespread improvement in the reputation of Northern Ireland eggs with the wholesale trade in Great Britain, and in a consequent improvement in demand. The universal grading and candling of eggs by wholesale dealers, which the Act involved, revealed, however, the extent to which eggs which were of inferior freshness and cleanliness were being marketed by producers. Consequently, by the Marketing of Eggs Act, 1926, it was made an offence for anyone to sell or have in his possession for the purpose of sale, eggs which were stale or which were dirty. Such an enactment may appear drastic. *Caveat emptor*—let the buyer beware—has been a motto which has applied too long in the sale not only of agricultural produce but of other goods. But when the wholesale trade was in the position of having to reject as unsuitable eggs which failed to attain a high standard of freshness and cleanliness, it was clearly inequitable

that producers should be left free to market stale and unclean eggs without let or hindrance. This was especially the case when the producer was deliberately holding up his supplies of eggs upon a rising market in order to obtain the advantage of an enhanced price. While, however, penal action against the producer who markets eggs of inferior quality may be essential in the interests of the trade as a whole, it cannot be the sole basis for marketing reform. The Ministry of Agriculture has not hesitated to use its powers under the Act of 1926 to prosecute producers guilty of marketing dirty and stale eggs. No less than 230 prosecutions for this cause have been instituted since the 1st January, 1927. But it is of even greater importance to seek to educate producers to market their eggs in good condition. Consequently, under the Act of 1931, power was taken to impose an annual licence fee. Wholesale dealers were divided into two classes : (1) dealers of Class A, who collected, tested, graded and packed eggs for the wholesale market either in Northern Ireland or Great Britain ; and (2) dealers of Class B, who merely collected eggs and sold them to dealers of Class A. Class B dealers may not sell eggs by wholesale, but only by retail direct to consumers. In the former case an annual licence fee of £3 was imposed, and in the case of Class B collectors an annual fee of £1. An additional licence fee of ½d. per 360 on all eggs exported to Great Britain was also imposed. The proceeds of this increased revenue from licence fees have been utilized for the purpose of maintaining a staff of educational officers whose work has consisted of visiting producers and giving instruction in the best methods of producing eggs and preparing them for market. The Act of 1931 also provided for the registration of the premises of wholesale dealers as well as for the licensing of the dealers themselves. This has enabled the Ministry of Agriculture to ensure that proper and adequately equipped premises are used, and that eggs are not handled in proximity to commodities such as fish, oil, or anything else likely to impair the quality of the eggs.

Finally, there has recently been passed the Marketing of Eggs Act, 1936. The main provisions of this Act are in relation to the fixing of prices for the purchase of eggs by licensed wholesale dealers from producers, and are dealt with later. But in addition the Act requires the licensing of all retailers of eggs (subject to the payment of a licence fee of variable amount), and enables the conditions under which eggs are sold, or exposed for sale, by retail to be prescribed. Retailers are now required to market eggs as either " new laid " or " seconds," and in order to comply with this condition they must either themselves candle eggs or purchase tested and graded eggs from Class A dealers. The only exception to the rule that eggs must be sold to the consumer accompanied by the above quality description is in

the case of direct sales to consumers by producers. The Act also enables the Ministry of Agriculture, acting on the advice of an Egg Marketing Committee created under the Act, to refuse a licence to any new applicant for a Class A or Class B licence if it appears "that there is a sufficient number of licensed wholesale dealers carrying on business in the area in which the applicant proposes to carry on business as such dealer." Hitherto no power has existed to refuse licences provided that the prescribed conditions were complied with, and at the 1st July, 1937, no less than 177 Class A licences and 1,431 Class B licences were in force. In the case of the Class A licence-holders, approximately 70 per cent. of the eggs shipped to Great Britain are handled by 23 firms, but the facility with which new licences could previously be obtained, and the ease with which new licence-holders could commence trading in eggs in areas already adequately served, have constituted a handicap, which it is now sought to remove, to the improved organization of the trade. These recent developments in egg marketing, however, may best be considered in relation to the developments which have occurred since 1932, not only in regard to eggs but in other fields of marketing, which are discussed later in this article.

The system of licensing wholesale dealers and the premises used for their trade, together with the establishment of standards for grading and packing, which has been described above in the case of eggs, was followed broadly in the Marketing of Potatoes Act of 1928 and the Marketing of Fruit Act of 1931. Both these Acts related more exclusively to the export trade than in the case of eggs. Under the Marketing of Potatoes Act, 1934, however, standards of grading, packing, and quality have been prescribed for potatoes sold in the city of Belfast, which standards are broadly similar to those for potatoes which are exported. Under the Marketing of Fruit Act, 1931, provision is also made to guard against the practice of "topping" fruit sold locally. While, naturally, legislation dealing with grading and standardization can most readily be applied to the export trade, which is concentrated in the hands of a relatively few merchants,[1] it has, nevertheless, been the policy of the Ministry of Agriculture to extend the regulations regarding the packing and grading of eggs, potatoes, fruit, and similar produce to the home trade whenever this has been found practicable.

The general scope and object of the marketing legislation outlined above may be paralleled by similar legislation in the case of many countries which are engaged in catering for the requirements of the British market. Grading to standard and

[1] There were at July 1st, 1937, 124 licence holders engaged in the export of eggs, 83 in the export of potatoes, and 50 in the export of apples.

the use of uniform packages have been found to be essential steps towards the acquirement and maintenance of reputation and quality. Prior to 1932, the home farmer, whether in Great Britain or Northern Ireland, enjoyed no privileged position over the Dominions, or over countries such as Denmark, Holland, and the new states on the Baltic, in catering for the British market in agricultural produce. Wherever home-produced agricultural products had to be marketed through wholesale channels it was found that the competition of carefully graded and attractively packed produce from overseas could be countered only by the sale of equally well graded and packed produce from home farms. The experience of Northern Ireland during the past fifteen years has amply demonstrated this fact. Prior to 1924, Northern Ireland eggs commanded a price inferior to many classes of imported eggs. In recent years the price realized for Northern Ireland eggs has been second only to the price realized for that select portion of English eggs sold under the National Mark Scheme[1] and above the price of "ordinary pack" English eggs. Similarly, after the passage of the Marketing of Potatoes Act, 1928, it was found that occasions occurred when Northern Ireland graded potatoes could be sold more readily on the Liverpool market than ungraded supplies from Lancashire.

The improvement in the sale of Northern Ireland eggs, fruit, and potatoes through the marketing legislation described above may be seen from the following figures :—

Table comparing shipments of Northern Ireland eggs, apples and potatoes from Northern Ireland for each of the years 1931 *to* 1936 *with the base period—taken in the case of eggs and apples as the average of the five years* 1926–1930, *and in the case of potatoes as the average of the three years, September* 1*st,* 1928–*August* 31*st,* 1931.

Year.	Eggs.	Apples.	Year.	Potatoes.
Base period	100	100	Base period	100
1931	120	268	1931–32	128
1932	126	310	1932–33	138
1933	130	331	1933–34	112
1934	153	119	1934–35	119
1935	173	732	1935–36	214
1936	174	414	1936–37	178

Shipments of Northern Ireland eggs and apples in 1936 were 2,496,023 long hundreds (120 eggs) and 132,795 cwt. respectively. For the year 1936–37 shipments of potatoes (taken for the period September 1st, 1936–June 30th, 1937) amounted to 201,160 tons.

[1] There have been occasions when quotations for Northern Ireland graded eggs on some markets have exceeded those for the corresponding National Mark grades.

The legislation passed between 1924 and 1931 not only resulted in a substantial improvement in the reputation and demand for Northern Ireland produce ; it also provided a firm foundation for the developments in agricultural marketing which have occurred more recently. In the preceding pages reference has been made principally to the Acts dealing with eggs, potatoes, and fruit. In addition, however, there were the Marketing of Dairy Produce Acts of 1929 and 1933, under which all creameries engaged in the manufacture of cream and butter were required to be licensed and to be adequately equipped. This legislation provided a sound quality basis for the operations of the Butter and Cream Marketing Scheme instituted in 1936, while the provision for veterinary inspection of all pigs used for bacon curing, and the licensing of all bacon factories, under the Agricultural Produce (Meat Regulation) Act of 1930 have been of invaluable service in connection with the operations of the Pigs Marketing Scheme.

The Agricultural Marketing Act, 1931, did not extend to Northern Ireland, but a somewhat similar measure was passed by the Northern Ireland Parliament in 1933 simultaneously with the passage of the Agricultural Marketing Act, 1933, by the United Kingdom Parliament. Certain differences exist between the Northern Ireland Act of 1933 and the provisions of the British Acts of 1931 and 1933. The main difference is probably that under the Northern Ireland Act a marketing scheme may be framed only by the Ministry of Agriculture, and that bodies of producers have not the right to frame and submit a scheme. In framing a scheme, however, the Ministry of Agriculture is required to "take into consultation representatives of the producers of the agricultural product proposed to be regulated and representatives of any other interests which may be affected by the scheme." Objections against a scheme framed by the Ministry may be lodged and a public enquiry into these objections held. Every scheme must be approved by the Ministry and ultimately by Parliament. The scheme, once approved, does not require a poll to be taken on the question whether it shall remain in force, nor does it require all producers to be registered. Once a scheme is approved its main provisions apply to all producers irrespective of whether they are registered or not. In essentials I do not believe that the absence of a poll has been a matter of consequence. The two schemes which have been framed by the Ministry under the Act, and which are still in force (the Pigs Marketing Scheme and the Butter and Cream Marketing Scheme), were both introduced only after the fullest and most complete consultation with the representatives of producers concerned. The draft of the Pigs Marketing Scheme was considered fully by the Ulster Farmers' Union and by the Agricultural

Committees in each county, while the Butter and Cream Marketing Scheme was also prepared in the closest consultation with the Ulster Agricultural Organization Society and the Ulster Creamery Managers' Association. The application of the scheme to all producers (and not simply to registered producers) is again a question of administration only, since under the British Acts producers who are not registered are prohibited from selling the regulated product. The omission of compulsory registration has, however, proved of great administrative convenience, since it has avoided the necessity for the registration of large numbers of small producers, and for the continual scrutiny of the register. Registration is, in fact, provided for, but with the primary purpose of providing an electorate for the election of members of the Board to administer the Scheme. Under both the Pigs Marketing Scheme and the Butter and Cream Marketing Scheme the election of members of the Boards to administer the Schemes is conducted by the Ministry by means of a postal vote. The electorate in the Butter and Cream Marketing Scheme is small, but in the case of the Pigs Marketing Scheme elections have aroused the keenest interest, and the number of registered pig producers was 33,113 on August 9th, 1937. It is of interest to record that the percentage of registered producers who exercised their vote at successive elections has been remarkably high, being 80 per cent. at the 1934 election and 70·5 per cent. at the 1936 election, clearly demonstrating the representative and democratic character of the Board.

While the differences outlined above exist between the British and Northern Ireland Acts, the powers which may be conferred on a marketing board under the Northern Ireland Act are practically identical with those which may be conferred under the British Acts. The grading of the regulated product is, however, reserved to the Ministry of Agriculture.

It has been previously mentioned that the bulk of Northern Ireland legislation dealing with marketing has been of a specific character. The Agricultural Marketing Act of 1933 is the one exception to this rule, and is a general enabling measure similar to the British Acts of 1931 and 1933. Its passage was due to the imminence of the introduction of the Pigs and Bacon Marketing Schemes in Great Britain in the autumn of 1933, and the necessity for the introduction of similar schemes in Northern Ireland. It was soon found, however, that greater flexibility could be attained by the passage of separate legislation for each commodity dealt with. In this connection it is not without interest to observe that most of the Re-organization Commissions which have dealt with the preparation of marketing schemes in Great Britain have recommended certain developments which have not been possible under the original Agricultural Marketing Act of 1931.

In the following pages I propose to describe the organization which has been adopted to date in connection with the re-organized marketing of pigs and bacon, milk and milk products, potatoes and eggs, together with some discussion of the problems which have been encountered in connection with each of these commodities.

I. Pigs and Bacon.

As has already been mentioned, a Pigs Marketing Scheme was framed under the Agricultural Marketing Act, 1933, and came into operation on October 1st of that year. A Bacon Marketing Scheme also came into force at the same date, but has since been allowed to lapse. In addition, under the Agricultural Marketing (Pig Industry) Act of 1934, a Pig Industry Council was created consisting of three representatives of producers nominated by the Pigs Marketing Board, three representatives of curers elected by the whole body of curers, and three members appointed by the Minister of Agriculture. The duties of the Council are to fix prices for the sale of pigs by producers to curers and to the Pigs Marketing Board, but such prices, before they come into operation, must be approved by the Ministry of Agriculture. It is also empowered to advise the Ministry of Agriculture with regard to all new licences for bacon factories, and may advise the Ministry to refuse to grant a licence "with a view to avoiding or reducing an excessive production of bacon." It may also recommend that certain conditions should be attached to the issue of a licence "with a view to promoting the efficient production of bacon."

During the past two years the work of the Pig Industry Council in regard to fixing prices and the licensing of new factories has become increasingly difficult owing to the development of two classes of pig trade in Northern Ireland—live and dead. Prior to 1934 all pigs cured in Northern Ireland were killed on the farm and sold dead to curers. No curer had abattoir facilities for the killing of pigs, and the fact that the great bulk of pigs were of the Large White Ulster type, a rather heavy soft pig which travelled badly, made the marketing of pigs alive almost unknown. The type of cure in Ulster bacon factories prior to 1934 was invariably a dry cure, the pig carcase, after its arrival at the factory, being split on the block, the hams cut off and the sides boned. A highly valuable market for hams was catered for, and the reputation of Northern Ireland hams was probably unrivalled. The sides were converted into rolled bacon and marketed in the industrial districts of the South of Scotland and the North of England. Current ex-factory prices[1] for hams are 145*s.* per cwt. and 90*s.* per cwt. for rolled bacon. As a

[1] August, 1937.

consequence of the high prices realized for hams, the Ulster type of cure has in the past been able to pay prices for pigs equal to the Wiltshire trade in Great Britain, despite the fact that the yield of dried bacon and hams per hundredweight of carcase is only 68 lb. as compared with 88 lb. of green bacon per hundredweight of carcase in the Wiltshire trade. Moreover, the Ulster curer does not obtain the value of the offal, as the pig is slaughtered on the farm and the offal retained by the farmer. Prior to 1933 the production of bacon and hams in Northern Ireland was approximately 370,000 cwt., of which quantity over one-third was made from pigs imported from the Irish Free State. Although catering for an important market, the Ulster type of cure has admittedly not been capable of great expansion, and the demand for bacon in the growing markets of the South of England has been for bacon of the Wiltshire type. It was the supply of this type of bacon, moreover, which was reduced by quantitative regulation of imports under the Lane Fox scheme. Consequently it has become increasingly necessary for Northern Ireland to develop a trade in Wiltshire bacon as well as in the old-established Ulster type of bacon. In advising the Ministry of Agriculture with regard to the establishment of new bacon factories, the Pig Industry Council has consequently refused to recommend the establishment of further factories unless these factories have been equipped with abattoirs for the killing of pigs and for the curing of these pigs in the Wiltshire style. Two new factories of this type were erected in 1934 and 1935, one capable of curing over 3,000 pigs per week and the second over 1,500 pigs per week. Licences for two further factories, each capable of handling upwards of 1,500 pigs per week, have been granted in 1937, but neither of these factories will be in operation before the middle of 1938. The establishment of these four new factories, which will jointly be capable of handling more than 7,500 pigs per week, is an indication of the rapid expansion in pig production which is taking place in Northern Ireland. In 1932 the production of pigs for bacon purposes was 290,000 head. In 1936 the number was 685,000, while in 1937 the number will be between 750,000 and 800,000. Concurrently with this development of Wiltshire curing factories in Northern Ireland, the Ministry of Agriculture has concentrated upon securing a change in the breed and type of pigs produced. In the remarkably short period of three years the Large White Ulster pig has been almost entirely replaced by the Large White Yorkshire breed, which experience has shown to be equally suited for the roll and ham trade as for the new Wiltshire cure.

In fixing prices for the sale of dead pigs the Council has been operating on the basis of a formula relating the price of pigs to realized prices of bacon and hams and fresh meats, together

with an allowance for the cost of feeding stuffs. The formula has necessarily been the subject of modification in the light of experience, but the basic figures in the formula at present in operation (August, 1937) are as follows :—

Yield of bacon and hams per cwt. of carcase . . = 68 lb.
Normal value of fresh meats per cwt. of carcase . . = 7*s*. 3*d*.

Therefore an initial pig price of 58*s*. per cwt. equals an initial price of bacon and hams of 97*s*. 6*d*. per cwt. after making an allowance of 14*s*., per cwt. of bacon and hams, for curer's costs.

The formula also contains provisions for sharing equally between producers and curers any profit or loss arising through the price of bacon and hams and fresh meats rising or falling above or below the basic figures in the formula. Provision is also made for sharing between producers and curers any increase or decrease in the cost of pig feeding due to the rise or fall of the cost of a standard ration above or below 7*s*. 3*d*. per cwt.

In 1935 some 440,116 pigs were sold dead and 71,748 pigs sold alive to bacon curers in Northern Ireland. In 1936 the figures were 526,737 and 132,567 respectively. During this period the practice of the Council was to fix the price of pigs sold live by reference to the price of pigs sold dead, which in turn was governed by the roll and ham formula explained above. Both prices were, of course, on a dead-weight basis, but it has been found by experience that the loss between live and dead weight in the case of abattoir-killed pigs is about 6 per cent. greater than in the case of farm-killed pigs, due to the effects of travelling the pigs to the abattoir and the change in their surroundings. In order to offset this greater loss in weight in the case of abattoir-killed pigs, and in order to encourage live pig marketing, the Council fixed the price of pigs marketed alive in 1936 at 5*s*. per cwt. above the price of pigs marketed dead. This represented the price to the producer. An arrangement was made, however, under which the Pigs Marketing Board agreed to recoup the curer if the Northern Ireland price for live pigs, arrived at in the manner outlined above, exceeded the full Great Britain formula price, less 1*s*. 6*d*. per cwt. Equally, the Wiltshire curers undertook to pay the Pigs Marketing Board any amount by which the Great Britain price, less 1*s*. 6*d*. per cwt., exceeded the Northern Ireland price for live pigs. This reinsurance arrangement between the Pigs Marketing Board and Wiltshire curers enabled the price of pigs sold live to Wiltshire curers in Northern Ireland to be pegged at a fixed margin above the roll and ham price during 1936. With the rapid increase in the number of pigs marketed alive and the growth of Wiltshire curing in Northern Ireland, it has become increasingly necessary to find a means of correlating pig prices between the Wiltshire and the Ulster trade. At the end of 1936 it was the intention of

the Pig Industry Council to adopt the "Greig award" prices in respect of the Wiltshire trade in Northern Ireland, but after the breakdown of fixed prices in Great Britain it was agreed that a Wiltshire price formula should be introduced similar to the roll and ham formula. The main features of the formula adopted for the Wiltshire trade at the beginning of 1937 were as follows :—

Yield of bacon per cwt. of carcase	= 88 lb.
Normal value of offal per cwt. of carcase . . .	= 5*s*. 7*d*.

Therefore an initial pig price of 63*s*. per cwt. equals an initial price of green bacon of 81*s*. 9*d*. per cwt. after making an allowance of 8*s*. 8*d*., per cwt. of bacon, for curer's costs. Sharing provisions similar to those operating in the roll and ham trade were also included in the formula.

It was provided that the roll and ham and the Wiltshire price formulæ should work independently, but that if the Wiltshire formula price was less than 4*s*. above the roll and ham formula price, then the Wiltshire price should be fixed 4*s*. above the roll and ham price. Equally, if the roll and ham formula price was more than 6*s*. below the Wiltshire formula price, then the roll and ham price should be fixed at 6*s*. below the Wiltshire formula price. In this way a definite relationship between the two trades was maintained. During the early months of 1937, however, the fall in the prices of Wiltshire bacon, which occurred simultaneously with a rapid increase in the cost of feeding stuffs, resulted in the margin between the realized price of bacon and the price to be paid for pigs narrowing from the standard figure of 18*s*. 9*d*. provided for in the formula to as little as 4*s*. 10*d*. in the month of March. As a consequence, the two Wiltshire factories then operating in Northern Ireland decided to close down.

I do not wish to discuss the merits of the controversy which arose as a result of this closing down of Ulster's two Wiltshire-style curing factories in the late spring of 1937. Broadly speaking, the facts may be summarized as follows. During the three months January to March, 1937, the realized prices of roll bacon and hams rose 11*s*. 10*d*. per cwt. as compared with the corresponding three months of 1936, and the average price of dead pigs under the roll and ham formula rose from 57*s*. 10*d*. in these three months of 1936 to 64*s*. 5*d*. in the same months of 1937. On the other hand, the average price of green Wiltshire bacon (Irish Wiltshire 1st Quality London, Wholesaler to Retailer) was 98*s*. 10*d*. in the first three months of 1936 and 99*s*. 10*d*. in the first three months of 1937. The Northern Ireland price for Wiltshire pigs rose from 62*s*. 10*d*. per cwt. to 70*s*. 2*d*. per cwt. between these periods. The worse position of the Wiltshire curers in Northern Ireland in 1937, compared with 1936, is therefore apparent. At the same time pig prices in Great Britain rose from 60*s*. 8*d*. during the first three months of 1936 (the full

formula price) to 72*s*. per cwt. in these months of 1937 (average of 1st and 2nd quality baconers at representative markets in England and Wales). While, therefore, it was open to producers to claim that Wiltshire curers in Northern Ireland were not being called upon to pay prices higher than were being paid by curers in Great Britain on the open market, it was nevertheless true that the price of pigs to Wiltshire curers had considerably advanced at a time when the price of bacon had remained practically stationary. An arrangement was finally made under which, from 1st July, 1937, the Wiltshire factories re-opened and agreed to pay for pigs a price equal to the average of 1st and 2nd quality baconers at representative markets in England and Wales. In months when this price was less than 4*s*. per cwt. above the roll and ham formula price the Pigs Marketing Board undertook to make up the price to the producer to at least that level.

As has been explained in the preceding paragraphs, the function of fixing prices for the sale of pigs by producers rests with the Pig Industry Council. The Council is not an executive body, however, and the responsibility for enforcing prices rests with the Ministry of Agriculture, while the responsibility for finding a market for any pigs which are not purchased by curers devolves upon the Pigs Marketing Board. Producers in Northern Ireland are not required to contract with curers for the sale of bacon pigs. The reason for this is twofold. In the first place, the market for fresh pork is almost negligible, and there is not the necessity which exists in Great Britain to differentiate between the bacon trade and the fresh pork market. To all intents and purposes, all pigs produced in Northern Ireland are for bacon purposes. In the second place, there are large numbers of small producers who do not market pigs regularly, but only once or twice a year. When a producer proposes to sell dead pigs he requires to obtain in advance a carcase card from a curer, so as to be certain that the curer will be able to take delivery. If, however, he is unable to sell his pigs dead to a curer he can always market them alive to the Pigs Marketing Board, which is required by the scheme to purchase all live pigs offered to it by registered producers and to pay for these pigs at the prices fixed by the Pig Industry Council, less such marketing charges as may be fixed. During a period when pig production has been increasing rapidly, the Pigs Marketing Board has had offered to it numbers of pigs considerably larger than it can find a market for in Northern Ireland, and large numbers have had to be exported. Live pigs exported in 1932 numbered 31,129. The figures for 1933, 1934, 1935 and 1936 were 61,153, 76,824, 84,623 and 47,386 respectively. During May, June, and July, 1937, when the two Northern Ireland Wiltshire factories were closed, no fewer than 42,615 pigs had

to be shipped to Great Britain. Since the Board is required to pay producers the prices fixed by the Pig Industry Council, and since a very large proportion of the pigs it buys has had to be exported to Great Britain (where they have to be sold to best advantage after transport charges have been met), and since also there is considerable loss in weight in the pigs during transport, it is apparent that the Board may be involved in heavy trading losses. The Ministry of Agriculture may, however, authorize the Board to collect a trading levy upon all pigs sold to it, or to curers in Northern Ireland, in order to recoup losses so incurred, and also to cover any payments to curers in connection with the price determinations of the Council. In addition, an administrative levy may be imposed, of such amount as may be approved by the Ministry, to cover the ordinary administrative expenses of the Board.

Since the establishment of the Pig Industry Council in 1935 the main functions of the Pigs Marketing Board have been in connection with trading. It has established some 30 centres at which live pigs are accepted from producers on different days each week. In addition, the Board has power to invest in bacon factories, and it is in fact making an investment of capital in the two new Wiltshire bacon factories which are at present under construction.

The grading of pigs at curing factories is undertaken by the Ministry of Agriculture. The staff employed are whole-time veterinary officers of the Ministry. As has already been mentioned, all pigs put into cure are inspected for disease under the provisions of the Agricultural Produce (Meat Regulation) Act of 1930. When the question of pig grading arose, it was decided that this work should be undertaken by the veterinary staff engaged on meat inspection at the factories, and in this way producers and curers have been assured of an efficient and absolutely impartial grading service.

II. Milk Marketing.

The milk marketing schemes in operation in England and Wales and in Scotland south of the Grampians have one great principle in common. They are both based upon the principle of pooling receipts from the liquid and the manufacturing markets. That principle was incapable of application in Northern Ireland because of the great volume of manufacturing milk. In 1936 approximately 15 million gallons were sold for liquid consumption in Northern Ireland and 25 million gallons manufactured into cream and butter at creameries. In addition, a large quantity of milk is made into butter on farms—probably at least 20 million gallons annually. It was at once apparent that a system of pooling receipts from the sale of liquid and

manufacturing milk could not operate successfully on account of the great volume of milk going for manufacture. Prior to the passage of the Milk and Milk Products Act of 1934, however, both the creamery industry and the liquid milk market were experiencing a time of the greatest difficulty. Production of milk for manufacture in creameries had been going on for more than 30 to 40 years. The co-operative creamery movement is, indeed, the development in agricultural marketing for which Ireland has hitherto been best known. The creamery system fitted admirably into the general economic structure of Irish agriculture in both North and South. On the small farms of Armagh, Tyrone and Fermanagh the dairy herd was the corner-stone of the whole agricultural system. Abundant grazing was available in the summer, the flush of milk obtained after spring calving was sent to the local creamery, and the separated milk returned to the farmer for feeding to his calves, pigs and poultry. Comparatively little winter fodder was grown apart from the large crops of hay of good quality which were normally obtained, and which provided the basis for a winter maintenance ration for the dairy herd. Little attempt was made to keep up milk yields during the winter. Cows generally calved in the spring and the calves were sold as six- or nine-months-old stores in the autumn. The summer milk was sent to the creamery and the receipts from its sale, together with the separated milk for feeding, provided a useful addition to the farm income. The drastic slump in butter prices which occurred in 1933 and 1934, however, made farmers even in remote creamery districts willing to attempt an invasion of the Belfast market for liquid milk, which had been made easily accessible by transport developments. The prospect of cheap milk led distributors to push out further and further afield in order to collect supplies for the liquid market, especially in areas where good roads existed.

A pooling system being impracticable, the Ministry of Agriculture decided that the most suitable policy for Northern Ireland conditions was to divide milk producers into different categories upon a quality (*i.e.*, a cleanliness) basis. Accordingly, under the Milk and Milk Products Act of 1934 it was provided that all milk should be sold in accordance with four quality grades, A, B, C and D, and that producers should be licensed for the production of the first three of these grades of milk. A licence is not required for the production of Grade D milk, but this milk may not be sold for liquid consumption. The standard for Grade A corresponds broadly with that for the old Certified grade in Great Britain. The milk is from cows which have passed the double intradermal tuberculin test, which is carried out by veterinary officers of the Ministry of Agriculture. In the case of Grades B and C milk, the cows must be clean and healthy

and show no clininal symptoms of tuberculosis. The byres and equipment of producers of Grades B and C milk must also comply with certain prescribed standards. All Grade B milk must be cooled at the farm to not less than 60° F. Grade B milk is subject to a bacteriological test of 300,000 per c.c., and for practical purposes differs from Grade A milk only in that the cows are not subject to the double intradermal tuberculin test. Grade C milk is subject to the Methylene Blue Reduction test on lines broadly similar to those applied to accredited milk in England and Wales. Grade D milk comprises milk produced by all persons who are not licensed for the production of A, B, or C milk, and may be sold only for manufacture. At the 1st July, 1937, there were licensed 56 Grade A producers, 961 Grade B producers, and 6,898 Grade C producers. The great majority of the Grade C producers are suppliers of milk to creameries, and do not sell milk on the liquid market.

The inspection of the dairy herds of A, B and C producers and of the byres and equipment of these producers is carried out by whole-time veterinary officers of the Ministry of Agriculture.

It has always been the policy of the Ministry of Agriculture to carry the grading of agricultural produce right through from the producer to the consumer wherever this is practicable. It was this policy, indeed, as well as the impracticability of a system of pooling milk receipts in Northern Ireland, which influenced the Ministry in framing the Milk and Milk Products Act of 1934 on the lines that have been described above. It appeared to the Ministry that to achieve the maximum of success a Marketing Scheme should, in addition to providing improved returns to the producer, also provide the consumer with a better article. It was particularly apparent in the case of milk that if consumption was to be increased the consumer must be given greater confidence in the quality of the milk supply. Consequently, the provisions of the Milk and Milk Products Act outlined above have been designed to improve the cleanliness of the milk supply in Northern Ireland and to ensure that all milk sold on the liquid market is from cows that are clean and healthy.

In the case of the large quantities of Northern Ireland agricultural produce which are shipped to Great Britain, the policy of quality grading to the consumer is impracticable owing to the intervention of the wholesaler. It has already been mentioned, however, that in the case of eggs recent legislation has provided for the licensing and control of retailers of eggs in Northern Ireland. In the case of milk, which is entirely sold locally in Northern Ireland, it appeared to the Ministry that the standards of quality demanded from the producer should be maintained by the distributor when selling to the consumer. Consequently, all distributors of milk are required to hold a

licence from the Ministry and to comply with certain prescribed conditions according to their class of trade—whether in A, B, or C milk. All milk of Grade A must be bottled on the farm and is simply distributed by the wholesaler or retailer. Grade B milk must be sold in bottles, but the bottling may be done either on the farm or at the distributor's premises. Grade C milk may be sold loose from churns which have to be labelled prominently as Grade C.

The prices for milk sold liquid are fixed by a Joint Milk Council whose functions and operations will be dealt with later. Certain deductions from these prices are payable by way of licence fees by all producers of A, B and C milk, when that milk is sold otherwise than for the purpose of manufacture. The maximum levies which may be imposed under the Act are $1d.$ per gallon on Grade A and Grade B, and $3d.$ per gallon on Grade C. The maximum levies on Grades B and C were in operation from December 16th, 1934 (when the fixing of milk prices first came into operation) until May 12th, 1935. Since the latter date the levies imposed per gallon have been $\frac{1}{16}d.$ on Grade A, $\frac{1}{4}d.$ on Grade B, and $1\frac{3}{4}d.$ on Grade C. The levies are the same irrespective of whether the milk is sold retail by the producer or to a distributor. In the former case the levy is payable direct to the Ministry of Agriculture, and in the latter is deducted by the distributor from the price paid to the farmer and remitted by the distributor to the Ministry. It will be seen later that the prices fixed by the Joint Milk Council for the sale of liquid milk are the same for Grades B and C. Consequently, the difference in the return to the producer is represented by a difference in the rate of levy, viz., $1\frac{3}{4}d.$ on Grade C and $\frac{1}{4}d.$ on Grade B. The distributor can thus purchase Grade B milk at the same price as Grade C, and will naturally only purchase Grade C when he cannot get Grade B milk. All levies are paid into a Milk Fund created under the Act. Payments to the Northern Ireland Milk Fund are also made by the Imperial Treasury under the Milk Act, 1934, corresponding to the payments in respect of manufacturing milk made to Milk Marketing Boards in Great Britain.

There is one further source of income to the Northern Ireland Milk Fund which requires special mention. Under the Milk and Milk Products Act, all sellers of butter and margarine are required to be licensed. The licence fee payable is £1 per annum plus a sum not exceeding 5*s.* per cwt. (at present 4*s.* 8*d.* per cwt.) on all butter or margarine sold. In the year ending March 31st, 1937, the total receipts of the Northern Ireland Milk Fund were £211,763, of which no less than £64,754 was derived from licence fees on sales of butter and margarine.[1] The system has proved

[1] £45,343 was collected in licence fees (and levies) from milk producers and distributors, and £100,229 received from the British Treasury under the Milk Act, 1934.

extremely easy to administer and has enabled the levies on producers of liquid milk to be fixed at a much lower level than would otherwise have been the case.

The proceeds of the Milk Fund are utilized to defray the expenses of administration of the scheme and then to assist producers who sell their milk for manufacture. In addition, schemes for the eradication of disease amongst dairy cattle, the encouragement of milk consumption and the supply of milk to school children at a cheap rate may be given financial assistance from the Fund. The assistance to producers of milk for manufacture has been of two kinds. In the first place, an equalization payment is made to creameries of an amount sufficient to raise the average price paid for milk by all creameries in Northern Ireland up to 5d. per gallon in the six summer months April to September, and 6d. per gallon in the six winter months October to March. In addition, a bonus of 1d. per gallon is paid on all Grade C milk sent for manufacture, and 2d. per gallon on all milk of Grades A and B.

As has been mentioned above, the fixing of prices for the sale of milk upon the liquid market rests with a Joint Milk Council. This body consists of seventeen members; seven elected by producers, four by distributors, three appointed by the Minister of Home Affairs[1] to represent consumers, and three (including the chairman) appointed by the Minister of Agriculture. In the event of disagreement between the representatives of producers, distributors and consumers upon the Council, the power to fix prices rests with the three members appointed by the Minister of Agriculture. This provision is similar to that recommended by the Grigg Re-organisation Commission for milk in 1933, who, it will be recalled, recommended the creation of a Joint Milk Council for England and Wales. The first prices fixed by the Northern Ireland Council were for the period December 16th, 1934, to May 12th, 1935. A further short-period price was then fixed to August 31st, 1935. Since that date prices have been fixed for periods of one year. The prices fixed for the year September 1st, 1935, to August 31st, 1936, were arrived at unanimously by the Council. The wholesale price for Grade B and Grade C milk was 12*d.* per gallon. The price of Grade A milk was fixed at not less than 2*d.* per gallon above the price of Grade B and C milk. As has already been mentioned, a levy of $\frac{1}{4}$*d.* per gallon is payable on Grade B milk and 1$\frac{3}{4}$*d.* per gallon on Grade C milk. The net price to the producer was therefore 11$\frac{3}{4}$*d.* in the case of Grade B milk and 10$\frac{1}{4}$*d.* in the case of Grade C milk. Deductions for carriage have, of course, to

[1] In Northern Ireland the Ministry of Home Affairs is responsible for health and local government services.

be made from these prices. The maximum allowance which the distributor is allowed to deduct for carriage was fixed in accordance with the following scale, which has remained unaltered ever since. When the distance between the purchaser's premises and the point at which milk is collected or the vendor's farm (whichever is the nearer to the purchaser's premises) :—

Does not exceed 5 miles					¾*d*.	per gallon.
Exceeds	5 miles but does not exceed	10 miles			1*d*.	,,
,,	10	,,	,,	,, 15 ,,	1¼*d*.	,,
,,	15	,,	,,	,, 20 ,,	1½*d*.	,,
,,	20	,,	,,	,, 25 ,,	1¾*d*.	,,
,,	25	,,	,,	,, 35 ,,	2*d*.	,,

Another ½d. per gallon may be deducted in respect of every additional 10 miles or part thereof.

The margin allowed to cover costs of distribution in Belfast and area in 1935–36 and 1936-37 was 8*d*. per gallon for Grade C milk and 10*d*. per gallon for Grade B milk, the extra 2*d*. per gallon in the case of Grade B milk being allowed to defray the costs of bottling the milk. (All Grade B milk must be sold bottled. Grade C milk may be sold loose.) It will be seen, therefore, that the retail price of Grade B milk is 2*d*. higher than in the case of Grade C milk. This is because of the additional service provided in the case of Grade B milk, and in Northern Ireland a definite attempt has been made to relate the distributive margin to the service performed. Consequently, a provision has always been inserted in the Council's determination permitting milk which is collected by a purchaser from the vendor's shop, dairy or farm to be sold at 4*d*. per gallon less than the appropriate retail price for that grade of milk. Large numbers of consumers have availed themselves of this provision, especially in the poorer parts of the city of Belfast, where milk is frequently collected by consumers from milk shops or dairies.

At the meetings of the Joint Milk Council in the summer of 1936 it was argued by producers that there should be an increase in prices on account of the tendency for prices of feeding stuffs to rise. Agreement could not be reached at the Council with regard to producers' prices, and accordingly the prices agreed to for 1935–36 were continued in 1936–37 by the appointed members, with a provision in the contracts between producers and distributors to the effect that the contract should be subject to any increase in price made by the Council during the year. In January, 1937, an increase in the producer's price for Grade B and C milk from 12*d*. to 14*d*. per gallon was made for the period January 24th to May 8th, 1937. A similar increase was also made in the retail price, so that the full cost of the increase in the price to the producer was borne by the consumer. During the year 1936–37 arrangements were, however, made by the Ministry of Agriculture on behalf of the Council to undertake an enquiry

into the costs of milk distribution. Arrangements were also made for the keeping of cost records on a number of farms catering predominantly for the liquid milk market.

At the meetings of the Joint Milk Council in July and August, 1937, particulars of the costs of distribution in 1936 by a number of firms handling about 50 per cent. of the milk sold in Belfast (exclusive of that sold by producer-retailers) were available. The accounts showed an average cost of distribution of just under $6\frac{1}{2}d.$ per gallon for milk sold loose, and it was agreed by the Council that for the year 1937–38 the distributive margin should be reduced to *7d.* per gallon for Grade C milk and *9d.* per gallon for Grade B milk. Full agreement could not be reached with regard to the price to the producer, however, and it was finally left to the appointed members to decide the question. Their decision was in favour of a price of *15d.* per gallon for seven winter months and *13d.* per gallon for five summer months, an average of $14\frac{1}{6}d.$ for the year. Deducting levies, this means for 1937–38 a net price to the farmer, subject to carriage deductions, of $13\frac{11}{12}d.$ per gallon for Grade B producers and $12\frac{5}{12}d.$ per gallon for Grade C producers, and these figures may be taken as comparable with pool prices in Great Britain. Adding the distributive margins agreed to by the Council, it will be seen that in 1937–38 the retail price in Belfast and area will be *2s.* per gallon for Grade B milk for seven months and *1s. 10d.* per gallon for five months. The retail price of Grade C milk will be 2d. per gallon less, while in both cases a reduction of *4d.* per gallon may be made if the milk is collected by the purchaser and not delivered. Outside the Belfast and Londonderry areas retail prices are lower than those mentioned above, as can be seen from the following table which summarizes prices for the year 1937–38.

Producer Prices.

	A*		B		C
October–April	17*d.*	...	15*d.*	...	15*d.*
May–September	15*d.*	...	13*d.*	...	13*d.*
Average	$16\frac{1}{6}d.$	...	$14\frac{1}{6}d.$	...	$14\frac{1}{6}d.$
Less Levy	$\frac{1}{10}d.$	...	$\frac{1}{4}d.$	...	$1\frac{3}{4}d.$
Net price	$16\frac{1}{15}d.$	...	$13\frac{11}{12}d.$	...	$12\frac{5}{12}d.$

Retail Prices.

	Belfast and Londonderry.			Country Towns.*			Seaside Towns.*			Rural Areas.*		
	A.	B.	C.	A.	B.	C.	A.	B.	C.	A.	B.	C.
October–April	2/2	2/-	1/10	2/-	1/10	1/8	2/-	1/10	1/8	1/10	1/8	1/6
May–September	2/-	1/10	1/8	1/10	1/8	1/6	2/-	1/10	1/8	1/8	1/6	1/4

* Minimum prices.

A deduction of *4d.* per gallon may be made when the milk is collected at a shop, dairy, or farm.

I will conclude this account of the Northern Ireland milk marketing scheme by a further table showing the quantities of liquid milk of each class sold during the twelve months ended March 31st, 1936 and 1937, and on which licence fees had been paid at June 30th, 1937. It was estimated that licence fees in respect of about 500,000 gallons of milk sold on the liquid market in 1936–37 were in arrears at that date. Allowing for these arrears it will be seen that consumption has increased by about 4 per cent., and also that there has been a marked tendency for the sale of Grade B milk to replace that of Grade C.

Year ended	Grade A.		Grade A.		Grade C.		Total
	Quantity.	%	Quantity.	%	Quantity.	%	Quantity.
	Gallons.		Gallons.		Gallons.		Gallons.
March 31st, 1936	1,365,968	10·3	7,465,995	56·4	4,399,868	33·3	13,231,831
March 31st, 1937	1,346,550	10·1	8,244,590	62·0	3,705,607	27·9	13,296,747

III. Butter and Cream Marketing Scheme.

The assistance given to manufacturing milk out of the Northern Ireland Milk Fund has already been referred to. Practically all milk used for manufacture in Northern Ireland is manufactured into cream or butter, the great bulk of it at co-operative creameries. With a view to improving the methods of marketing these two products, a Butter and Cream Marketing Scheme was framed by the Ministry of Agriculture in the early part of 1936 and came into operation on May 5th of that year. The scheme is administered by a Marketing Board of eight members, of whom three are appointed by the Ministry of Agriculture, and is largely regulatory in character. The bulk of the butter produced in Northern Ireland is sold locally, and within recent years a large trade in roll butter direct from creameries to retailers has developed and is expanding. With a view to stimulating the sale of butter, the Ministry of Agriculture has introduced a butter grading scheme under which creameries are required to submit samples of butter from each churning. A special Premium wrapper may be used by creameries which maintain a definite standard of quality for their butter, and the Butter and Cream Marketing Board has undertaken a special advertising campaign for this butter. The Board also fixes prices for butter each week, and has eliminated undercutting by creameries amongst themselves.

While the bulk of the butter produced in Northern Ireland is sold locally, the same is not true of the cream produced, which is principally exported. The power to fix the prices at which cream may be sold rests with the Butter and Cream Marketing Board, which has also required that all cream shall be sold

through its agency. The Board has also undertaken negotiations with the English and Scottish Milk Marketing Boards with regard to the sale of Northern Ireland cream in Great Britain. One of the principal advantages of the scheme has indeed been the fact that it has enabled Northern Ireland to enforce the price agreements arrived at from time to time with the English and Scottish Milk Marketing Boards with regard to the sale of cream, and has enabled Northern Ireland to participate on a regulated basis in the development which is taking place in the English cream market.

IV. Potatoes.

As has previously been mentioned, legislation dealing with the grading of potatoes shipped to Great Britain has been in operation since 1928, while grading was also instituted for the Belfast market in 1934. There has been for many years a substantial trade in potatoes between Northern Ireland and parts of England and Wales, and, with the introduction of the Potato Marketing Scheme in Great Britain at the end of 1933, it became necessary to make provision for the marketing of Northern Ireland potatoes on the British market in accordance with an organized plan. In regard to quantity it was arranged with the Potato Marketing Board that the normal shipments of potatoes from Northern Ireland to Great Britain should be 200,000 tons per annum. It is estimated that normal requirements of potatoes for the British market amount to 4,200,000 tons per annum, of which 4,000,000 tons represent the British supply and the balance shipments from Northern Ireland. It is understood that it is on the basis of this estimate of normal requirements that the policy pursued by the various bodies interested in the regulation of imports of potatoes has been based.

In order to prevent an excessive quantity of potatoes from Northern Ireland affecting the market position in Great Britain it has been agreed with the Potato Marketing Board in Great Britain that shipments of Northern Ireland potatoes shall be limited to 200,000 tons in years when the estimated normal requirements of the British market are available from home farms. In years when imports are necessary it is, of course, open to Northern Ireland to exceed her normal shipment of 200,000 tons.

In addition to regulating supplies, the Potato Marketing Board in Great Britain has sought to secure the regulation of prices. In this direction also there has been co-operation from Northern Ireland, and in the autumn of 1935 a North of Ireland Potato Marketing Association was formed with an Executive Committee consisting of eight representatives of merchants, two representatives of producers nominated by the Ulster Farmers' Union, and one representative of the Ministry of

Agriculture. The Association recommends each week a price for Northern Ireland potatoes at which merchants shall sell in various markets in Great Britain. Although the Association has no statutory power to enforce its price recommendations, it has been found that these have been well observed by the trade. The presence of representatives of producers on the Executive Committee has also ensured that prices to producers have been constantly scrutinized in the light of the prices realized in Great Britain.

V. Marketing of Eggs Act, 1936.

An account has already been given of the principal features of the re-organization of egg marketing which has taken place in Northern Ireland between 1924 and 1936. The Marketing of Eggs Act, 1936, however, introduced one further feature of special importance. It authorized the Ministry of Agriculture, acting upon the advice of an Egg Marketing Committee created under the Act, to fix the prices at which eggs should be purchased by licensed wholesale dealers from producers. The basis for price fixing has been the subject of a recent report from the Egg Marketing Committee to the Ministry. It is recommended that prices to the producer should in future be fixed by reference to the prices realized by licensed wholesale dealers from the sale of their eggs, and that merchants of Class A and Class B should in future receive a definite fixed margin for their services. In the case of Class A merchants, the Egg Marketing Committee (which consists of five representatives of Class A merchants, two representatives of Class B merchants, five representatives of producers and three members—including the chairman—appointed by the Minister of Agriculture) has recommended that a service margin of 14*d.* per long hundred (120) should be fixed to cover the cost of collecting, packing, grading and testing eggs, including all overhead expenses. In addition, the cost of packing cases and fillers and flats will be allowed, but since the cost of these items varies it is intended that the additional margin to cover these expenses shall be reviewed and adjusted every three months. The price to the producer will be arrived at each week by deducting this service margin from the average realized price of eggs sold by Class A merchants.

In the case of Class B licence holders who are simply collectors of eggs and who dispose of all their eggs to Class A licence holders, it is recommended that a payment of $\frac{7}{16}$*d.* per lb. of eggs should be allowed. (This payment will, of course, be made by the Class A merchant out of his service margin.) It is also recommended that where a producer delivers his eggs to a Class A merchant's store (so saving the expense of collection), the producer should receive $\frac{1}{2}$*d.* per lb. above the current statutory price.

It is hoped that the system of price fixing recommended by the Egg Marketing Committee and described above will come into operation in the early autumn of 1937. The price determined on the basis of the formula outlined above will be payable only in respect of new-laid eggs which comply with the standard of freshness laid down in regulations under the Acts. The price of "second" eggs will be fixed at a much lower figure, and consequently producers who are guilty of holding eggs on a rising market will be penalized by receiving a lower price. There will thus be a powerful incentive on producers to market their eggs regularly and in good condition. It is as yet too early to comment upon the results which may be achieved. The proposals outlined have, however, been recommended unanimously by the Committee, and it is not to be doubted that the machinery created will at least ensure the producer a price for his eggs which will be directly related to the price at which Northern Ireland eggs can be sold on the wholesale markets of Great Britain.

The foregoing account of what has been attempted in recent years in regard to the improvement of agricultural marketing in Northern Ireland indicates the comprehensive character of the changes which have occurred. Milk, pigs, eggs, potatoes, butter, cream and fruit have all, in greater or less degree, become the subject of regulation in regard to their methods of marketing. The value of the output of these commodities was approximately £8,800,000 in 1935–36 out of a total agricultural output of just over £14,000,000. Since 1933 machinery for fixing, upon a statutory basis, the prices to be paid to producers of pigs, milk, eggs, butter and cream has been created. It may be claimed, broadly that, with one or two important exceptions, the methods of marketing of all the principal agricultural products of Northern Ireland have been the subject of re-organization. The two principal commodities which have not yet been tackled are cattle and poultry. In the case of both, the activities of the small higgler and dealer stretch far over the land, and it is probable that it will be to cattle and poultry that the next major efforts in regard to marketing re-organization in Northern Ireland will relate.

D. A. E. Harkness.

Stormont,
Belfast,
13th August, 1937.

THE TAKE-ALL OR WHITEHEADS DISEASE OF WHEAT AND BARLEY, AND ITS CONTROL.

Introduction.

The take-all or whiteheads disease of wheat due to the root-infecting fungus *Ophiobolus graminis*[1] has unfortunately been on the increase in England during the last few years. The present situation may be attributed in part to changes in methods of wheat farming, forced on the farmer by changing economic conditions. The abandonment of the former four- and five-course rotations and of live stock on many farms, and the sometimes greater frequency of cereals in the rotation, have favoured the multiplication of this cereal parasite.

The "spread" of this disease in the wheat-growing counties is apparent rather than real, for the take-all fungus is indigenous on a number of English grasses, and has probably been an inhabitant of English soils for longer than wheat has been grown here. At the present time, occasional diseased plants can be found on many farms where the owner is unaware of their presence; the fungus is there, but is restricted by farming methods or by the type of soil from causing serious loss. Were the present conditions changed the disease might break out and cause loss at any time.

The present situation is therefore one to cause concern rather than serious alarm, for the disease is certainly one that can be kept in check if suitable precautions are taken. Of the various control measures that can be applied, some have been worked out by farmers in Australia, where the disease has been known for upwards of eighty years, whilst others are the result of recent scientific investigation. It is interesting to find, moreover, that certain of the recommendations to be put forward for the control of take-all represent a return to farming practices formerly prevalent in certain parts of England, but since abandoned or modified.

The most serious outbreaks of take-all so far noted have been on the lighter chalk soils of Wiltshire, Hampshire, Cambridge, Norfolk and Yorkshire. Such soils unfortunately offer particularly favourable conditions for its occurrence. In the second place, certain years, such as 1935 and 1937, seem to be marked by more widespread outbreaks of take-all than other years.

[1] All outbreaks of whiteheads so far seen by the writer have been associated with the fungus *Ophiobolus graminis*. *Fusarium culmorum*, which has frequently been reported as associated with the development of the whitehead condition, has been found in these investigations only as a secondary invader in roots and stems originally attacked by *Ophiobolus graminis*. The Wheat Stem Saw-fly, *Cephus pygmaeus*, can also produce whiteheads in wheat.

Country-wide fluctuations in the severity of a disease must be caused by a climatic factor ; in this case, the predisposing factor may be a mild winter, which must permit a greater extension of the fungus on the roots of the autumn-sown crops than does a winter of normal severity.

Field Development of the Disease.

The symptoms of the disease are variable, being produced by attack of the fungus on the underground parts of the plant. The effects may become apparent at any time from the recommencement of growth in the spring up till emergence of the heads. In more severe infections plants may be killed when 6 to 8 inches high ; such early killing may appear in the form of patches of stunted and dying plants, but these early-killed plants may also be dispersed singly or in small groups throughout the crop ; the latter form of occurrence is less noticeable and is hence often overlooked. This early killing is often referred to as the take-all stage of the disease, and was originally thought to be distinct from the later or whiteheads stage until the two were associated and shown to be due to the same fungus, by the Australian plant pathologist, McAlpine, in 1902 (Ref. 1).

The whiteheads form of the disease first appears after emergence of the head, and is manifested as a rather sudden bleaching-off of the whole plant, which goes a dead-white colour, distinct from the normal golden yellow of ripening corn. The ears fail to fill out, so that such plants generally yield little grain, and that mostly tail corn. The effects produced by the disease can be much modified by the weather experienced at heading time ; hot, dry weather leads to intensification of the whitehead symptoms and increases the loss of potential grain due to the disease, whilst cool and rainy weather in July and August will permit infected plants to mature better-filled grain in the ears, as was seen in 1936.

As Samuel (Ref. 2) has pointed out, however, the take-all and whiteheads stages of the disease grade imperceptibly into one another and all intermediate stages can be seen. The same applies to the distribution of infected plants ; whilst early-killed plants are most noticeable in patches, and the whiteheads are generally scattered throughout the crop, the reverse form of distribution is sometimes seen. Again, in more serious outbreaks, attacked plants in all stages of the disease are generally distributed in large, ill-defined patches throughout the crop ; indeed it may sometimes be more correct to speak of patches of healthy plants.

The form taken by the disease has been attributed by some investigators to the amount and distribution of the fungus in the soil at the time of planting the crop, take-all patches occurring

with heavier concentrations of inoculum, and whitehead plants where the initial concentration of the fungus in the soil had been lower. This explanation may be frequently correct, but a similar effect could also be produced by variation in soil type over a uniformly infected field; in patches of soil particularly congenial to the fungus, underground spread over the roots of the plants would be rapid, and early killing would ensue; in less favourable soil, advance of infection would be slower, and whitehead plants eventually result.

When infected plants are pulled up for examination, a blackening of the base of the stem will generally be found on pulling away the protecting leaf-sheaths. This blackening is due to the mycelium of the parasitic fungus. If the season has been a wet one, small dark bodies, of the size of a pin's head, may be seen on holding the innermost leaf-sheath up to the light, though frequently they do not develop until after harvest, on the standing stubble. These are the spore-cases, or perithecia of the fungus, from which the spores are eventually ejected. The possible importance of these spores in the dissemination of the disease will be discussed below.

Where blackening of the base of the stem, or of the roots after washing, has been observed, the investigator may feel reasonably sure that the take-all or whiteheads condition of the plants has been caused by the true take-all fungus, *Ophiobolus graminis*. The premature ripening and empty head are caused by infection of the roots and stem-base, and the resulting dislocation of root-absorption and translocation of food material up the stem; the fungus itself never grows up the stem for more than a few inches above the ground, and so the disease cannot be seed-borne, as are the cereal smuts. Blackening of the dead and empty ears of the whiteheads can be brought about in a wet summer by the growth of non-parasitic mould fungi, such as *Cladosporium herbarum*,[1] but this has nothing to do with the cause of the whitehead condition.

In conclusion, it may be pointed out that the take-all fungus never causes lodging or laying of the crop. It is true that the stem bases of lodged plants at harvest time may be blackened in a manner suggestive of the take-all fungus; lodging of this type, associated with blackening of the stem, is caused by another parasitic fungus, *Cercosporella herpotrichoides* (Ref. 3), and has been rather prevalent during the past season. If lodged plants are dug up and washed free of soil, their roots will be found white and healthy; the lowest or underground portion of the stem is also often clean. On the other hand, whitehead

[1] See Bennett, F. T., on "*Cladosporium herbarum*:—The question of its parasitism, and its relation to 'thinning out' and 'deaf ears' in wheat." *Ann. Appl. Biol.*, 1928, **15**, 191.

plants, dug up and washed free of soil, will always show some blackened roots, and the blackening of the stem always proceeds from the crown or base upwards. It may also be observed that whereas the most severe outbreaks of take-all are usually associated with the poorest and lightest patches of soil in a field, the lodged plants occur rather on the richer, heavier and damper areas.

Underground Life-cycle of the Parasitic Fungus.

After the harvesting of a crop attacked by this disease the fungus persists as mycelium inside the infected root and stubble tissues. If another crop of wheat or barley be sown a few weeks after turning in the diseased stubble, infection of the new crop will certainly occur. The fungus lies dormant in and on the diseased tissue buried in the soil until the roots of the young crop come into contact with it, when infection occurs.

The subsequent progress of the disease depends very much upon soil conditions. If these are favourable to it, the fungus grows comparatively rapidly along the roots, spreading from one plant to another where there is root contact, and up the roots of individual plants until it reaches the crown or stem base, upon which it establishes itself. Once the crown is infected the plant may not recover, since new roots can be destroyed as they are put out, and the fungus penetrates the stem and interferes with the functioning of the vascular system. The length of time taken by the fungus to reach this position from outlying infections of the root system thus depends not only upon the amount and distribution of infection in the soil but also upon the rate of growth of the fungus under different soil conditions. If, on the other hand, soil conditions are unfavourable to the fungus, infection from the diseased plant residues may be inhibited altogether; even if it does occur its progress along the roots will be much slower than in a favourable soil, and it may reach the crown too late to cause appreciable damage. Soil conditions unfavourable to the growth of the fungus along the roots may thus localize outlying root infections and exert a real check on the progress of the disease.

The fungus grows most rapidly along the roots of the crop in alkaline soils and in well-aerated soils, *i.e.*, soils of light texture and soils in a loose, open condition. Conversely its growth is slow in acid soils, and in heavy or well-compacted soils (Ref. 4). These facts are considered largely to explain the distribution of the take-all disease on different types of land; it is most prevalent on alkaline soils and on soils of light texture. Thus in England it occurs most seriously on the lighter chalk and limestone soils, whilst in South Australia also it is troublesome only on the light-textured alkaline soils (Ref. 4). Again, in South

Australia, the opening-up of the soil by too deep cultivation, or by the ploughing-in of long straw, has always been found to aggravate the occurrence of take-all, so much so that in the early days of wheat growing the disease was held to be a mechanical one, due to faulty cultivation (Ref. 5). For this reason the preparation of a firm seed-bed for wheat ranks in Australia as one of the foremost control measures applied against the disease (Ref. 6), whilst many striking cases of the beneficial effect of sheep-trampling the land have been reported by farmers.

Soil conditions influence the take-all fungus not only in its active or parasitic phase on the roots of the growing crop. They also affect the rate of its disappearance from the infected root and stubble residues buried in the soil after the harvesting of a diseased crop. The fungus cannot live on the soil organic matter, and in the absence of a suitable host plant must eventually die out. Whilst starvation alone might thus bring about its disappearance from the soil, its dying-out is now known to be greatly hastened by the other soil micro-organisms, certain of which can attack and decompose its resting mycelium. Work now in progress indicates that those conditions of soil temperature, moisture, etc., favouring increased activity of the general soil microflora promote also the more rapid disappearance of the take-all fungus from infected stubble buried in the soil. The survival period of the fungus has been experimentally reduced by more than half by burying green manure in the soil along with the infected stubble; the green manure produces rapid multiplication and increased activity of certain classes of soil micro-organisms which are held to be responsible for the decomposition and disappearance of the resting take-all fungus.

Survival of the Fungus.

Work still in progress indicates that the period of survival of the fungus in root and stubble residues left in and on the soil after a diseased crop varies widely, both according to the type of infected material and the nature of the soil. Since the disappearance of the take-all fungus from such infected material seems to be due as much to its decomposition by the other soil micro-organisms as to starvation in the absence of a suitable host, it is not surprising that soil conditions should affect the length of the survival period. Thus green manuring shortens the survival period, most probably by promoting the activity of other soil micro-organisms antagonistic to the take-all fungus. Again, the fungus disappears more quickly when infected stubble is ploughed under the soil and allowed to decompose than when it is left standing.

It is thus impossible to state categorically how long the fungus will survive in infected material left in the soil after a diseased crop, and whether one year under fallow or a non-susceptible rotation crop will always be sufficient to rid the soil of the fungus. In some soils a year is amply sufficient for this purpose, and, indeed, a shorter period than this may suffice. On the other hand, field observations definitely show that there are certain soils in which the fungus can sometimes survive for rather more than a year; infected crops of wheat and barley may be seen on these soils, for instance, after sugar beet.

Survival of the fungus over periods of fallow and non-susceptible crops may be assisted, of course, by the growth of arable weeds and pasture grasses acting as alternate hosts to the parasite. Thus both Italian and Perennial Rye grasses (*Lolium italicum* and *L. perenne*) are susceptible to infection, and are capable of carrying the fungus on their roots without giving any indication in the growth of the tops. Common arable weeds acting as hosts are Couch grass (*Agropyrum repens*) and Slender Foxtail (*Alopecurus agrestis*) on the heavy land, and Barley grass (*Hordeum murinum*) on the lighter soils. On weedy fallows, therefore, the take-all fungus is enabled to survive on the living roots of susceptible grass hosts. As far as is known, only grass weeds can act as hosts. Sooner or later, therefore, trouble with weeds is almost certain to be followed by trouble with take-all.

The growth of weeds, however, can scarcely account for the survival of the fungus under a clean-cultivated crop of roots or sugar beet. It has been suggested, therefore, by Samuel and Garrett (Ref. 7) and Samuel (Ref. 2) that infection in wheat or barley grown after roots or sugar beet may be due to dispersal of the take-all fungus by means of its spores, which are produced in the small black fruiting bodies formed on infected stubble after harvest. Thus spores produced on infected stubble might be blown over adjacent crops of young wheat on clean land, either in autumn or in the following spring. This suggestion offered both an explanation of puzzling features in the occurrence of the take-all disease and a hope for its better control, *i.e.*, by ploughing-up infected stubble immediately after harvest and thereby removing the source of air-borne infection.

There is certainly no doubt that spores are produced and ejected into the air in large numbers from the fruiting bodies of the fungus formed in infected stubble. Experiments at present in progress have unexpectedly indicated, however, that infection by these wind-blown spores may occur only in exceptional circumstances, if at all. This finding certainly requires confirmation and elucidation but, in the meantime, it hardly seems necessary to take precautions against the now doubtful spread of take-all infection in this way.

The conclusion that infection must generally come from the soil is supported by field evidence from the past season, during which outbreaks of take-all on a number of farms in different parts of the country have been investigated. Severely diseased and quite clean crops have not infrequently been seen standing side by side on the same land; such crops were sometimes on the two halves of one field on which different rotations had been followed.

CONTROL MEASURES.

(*a*) *Crop Rotation.* Only cereal crops are susceptible to the disease; barley may suffer as severely from take-all as wheat, though the symptoms are not generally so striking. No varieties of wheat resistant to the disease are known, nor is it very likely that one will be found, since the take-all fungus is by no means as specialized in its nutritive requirements as the rust fungi. In general, red wheats suffer less from the disease than white wheats. Oats are regarded as immune in Australia, and appear to be a safe rotation crop in England, though in Wales they have been attacked. Since no cases of take-all on oats have been reported in England, the ordinary varieties of oats may be safely recommended at present for take-all infected land.

A seeds mixture containing ryegrass must be reckoned as a susceptible crop; although the grass may appear perfectly healthy it can carry the take-all fungus on its roots. It is hence a source of danger to a following cereal crop, unless an adequate interval is allowed for the disappearance of infected material between ploughing up the seeds ley and drilling the cereal crop.

(*b*) *Eliminating infected material from the soil.* After harvesting a take-all diseased crop, as long an interval as possible should be left between ploughing-under the diseased stubble and planting another cereal crop. The length of interval required for decomposition of the infectious material in the soil will depend both upon the amount of disease in the crop just harvested and upon the nature of the soil.

If no whiteheads at all can be detected in the crop at harvest, it will probably be safe to follow with another crop of wheat if so desired. But if the soil happens to be one favourable to the spread of the disease in the crop, *e.g.*, light and chalky, a mere sprinkling of whiteheads in the first crop can be sufficient to lead to severe losses in the following one.

The survival period of the fungus appears to vary widely with the nature of the soil. It seems to be shorter in heavy than in light soils; it can be shortened by green manuring, and the disappearance of the fungus will be more rapid in soils that have been well "mucked" than in those deficient in humus and low in general fertility.

The amount of disease developing in the crop depends not only upon the amount of infective material surviving in the soil but also upon whether the soil is favourable or not to the spread of the disease on the roots of the crop. Thus a given amount of infective material in the soil at the time of drilling may produce a severely diseased crop on light chalky soil and a negligible loss from whiteheads on a heavy soil, especially if this is on the slightly acid side.

The situation may be summarized as follows. On heavy soils it may be safe to take a second wheat crop after one showing a sprinkling of whiteheads, provided that ploughing is done early and drilling late. Thus there is no doubt that wheat can be taken for two years at a time on the Rothamsted clay soil without serious trouble from the disease. On less heavy soils it may still be possible to follow a slightly diseased crop with spring wheat or barley if so desired. On light soils, especially those with a high chalk or lime content, a full year's rest from a cereal should be given. Finally, there are certain soils, such as the Breckland type over chalk in Norfolk, in which infectious material can apparently survive for a full year under sugar beet and cause serious loss in the spring barley crop following.

Where it has been decided to risk a second crop of wheat, drilling should be done as late as possible. The later the crop is drilled in the autumn the more of the infectious material will have gone from the soil. In the second place, the later the crop is sown the less time will the fungus have in which to secure a hold on the young plants before it is stopped by the winter cold. For this reason, mild weather in early winter is considered to be favourable to take-all, since it allows the fungus to secure a firmer hold on the root systems before it is checked by low temperatures.

In Australia, the practice of burning the stubble after harvest affords a measure of take-all control by destroying all infectious material above ground, and thus reducing the amount of diseased residues left to infect the next cereal crop. The stripper is employed for harvesting, and the long straw never fails to burn well after the hot, dry summer. In England, some farmers have attempted to imitate this practice by setting the combine harvester to cut the straw half way up, thus leaving a stubble long enough to burn. If a sufficient spell of hot, dry weather is not obtained after harvest, however, a burn cannot be obtained, and the long stubble must be ploughed under. This will loosen the soil and make it much more favourable for the development of take-all in the next crop.

Finally, there is the question of how long a time should elapse between ploughing up a pasture ley suspected of carrying infection and drilling a crop of wheat. In the past, wheat after pasture has frequently suffered severely from take-all, generally

because no appreciable interval has been left between ploughing-up and drilling. Most farmers can recognize the danger of following up an obviously diseased wheat crop with a second one without allowing a sufficient interval for the disappearance of infectious material from the soil. The appearance of a pasture, however, generally gives no indication of the disease it is carrying on its roots, and thus offers no warning to the farmer against the danger of immediately drilling-in wheat.

Ryegrasses can certainly carry the disease, and indeed appear to be congenial hosts to the take-all fungus. A ryegrass and clover mixture after a take-all diseased crop will thus be carrying the disease on its roots. Since grass roots decompose more quickly than cereal stubble in the soil, the interval between ploughing-up and drilling need not be so long after a seeds ley as after a diseased cereal crop. For example, a ryegrass and clover ley on the site of a very severely infected field on a Hampshire farm was ploughed in the latter half of July and drilled in the latter part of October. In the resulting crop only very few whiteheads could be found. In this case three months had been sufficient to get rid of the fungus carried on the roots of the ryegrass; its disappearance was probably hastened by a wet July and August (1936), and by fowl dung and the green residues of the ley, which were ploughed in.

(*c*) *Checking underground spread of the fungus on the roots of the growing crop.* The fungus spreads underground most rapidly in light soils and in loose and open soils; it is also favoured by chalky soils and by liming. It can therefore be controlled by compacting the soil as much as possible and by avoiding lime and alkaline fertilizers.

In Australia, great emphasis is laid on a compacted soil as a control for the disease. Every effort is made to prepare as firm a seed-bed as possible, and all cultivation operations on the wheat fallow are directed towards this end (Ref. 6). The depth of cultivation has been reduced to 2–3 inches on the very light soils and the compacted under-layers are left undisturbed. Very striking instances of the effect of compacting the soil on the control of the disease are to be seen. The keeping of a flock of sheep on light land is a great help towards this end.

Farmers on light land in England might therefore imitate these Australian methods with advantage—by reducing the depth of cultivation and sparing no effort to compact the underlayers. The rolling of crops in the spring may be found helpful, but this will depend on the depth to which the compacting effect can be extended.

For the same reason, farmers on heavy land where take-all has appeared should avoid loose and cloddy seed-beds, or the ploughing-in of long straw, which is liable to open up the soil.

The latter operation, in particular, creates especially favourable conditions for the activity of the take-all fungus, as has been demonstrated many times in the field.

Finally, since the disease is worst on chalky land and on alkaline soils generally, liming should be avoided, and neutral or acid fertilizers are to be preferred to alkaline ones; superphosphate should be used in preference to basic slag, and sulphate of ammonia rather than nitro-chalk.

(*d*) *Manuring*. There is no doubt that plants growing in a soil characterized by general low fertility suffer more severely from the disease than do plants growing in a good soil. The application of a general fertilizer may not actually check the progress of the disease much, but it will help the crop to stand up better to the effects of it. When growing in a fertile soil the wheat plant has a remarkable power of putting out fresh crown roots to replace those attacked and destroyed by the take-all fungus (Ref. 8), and this constitutes a real measure of resistance to the disease.

It is better still to maintain a high level of fertility by liberal "mucking" where this is possible, since there is reason to believe that such a policy will not only produce a vigorous plant, but will also check the spread of the take-all fungus along the roots and hasten its disappearance from infected stubble buried in the soil after a diseased crop.

Finally, superphosphate seems to exercise a specific controlling effect on the disease (Ref. 6), probably by promoting vigorous root development. It should therefore always be applied when in doubt as to the phosphate status of the soil. In Australia this manure is drilled in with the seed, and this is undoubtedly the most effective and economical method of applying it.

Summary of Control Measures.

(1) Farmers on light land, and especially those on chalky soils, must take much stricter precautions against the take-all disease than those on heavy land and on soils with a lower lime content.

(2) Secure a firm seed-bed before drilling, and on light land compact the soil in spring by repeatedly rolling the crop. On light soils the depth of cultivation might be reduced in some cases with the same end in view. For the same reason avoid loose, cloddy seed-beds on the heavier soils, and do not plough in long straw.

(3) Do not apply lime except on sour land or when necessary for other crops, and use superphosphate and ammonium sulphate rather than basic slag and nitro-chalk.

(4) Do not grow wheat after wheat where the first crop has shown even a sprinkling of whiteheads. A second crop of wheat

can be taken with safety only on heavy land on which take-all is not troublesome, and even then it is advisable to plough early and drill late so as to leave as long as possible for the fungus inside the stubble to decompose in the soil. On light land it will be dangerous to grow spring wheat or barley after a crop showing whiteheads. Finally, on the very light Norfolk Breckland soil, take-all can occur in wheat and barley after sugar beet, though severe attacks may be limited to areas where the lime content of the soil is high. Field experiments now in progress may show a way of shortening the survival period of the fungus on this and other light soils.

(5) Leave at least a three months' interval between ploughing-up a pasture ley (whether a one-year ley or an older ley) and putting in a wheat crop, for the take-all fungus may be present on the roots of the pasture grasses, especially ryegrass.

(6) Keep down grass weeds on the fallows and amongst other crops; trouble with weeds will probably be followed by trouble with take-all.

(7) Manure well according to the requirements of the soil, and do not omit superphosphate. Organic manures are to be preferred where possible, since they may be expected also to accelerate disappearance of the take-all fungus from the soil and to check its underground activity on the roots of the crop.

Acknowledgment. I should like to take this opportunity of thanking all those who are giving me assistance with the field investigation of this problem; in particular I should mention Mr. W. Buddin and Dr. W. A. R. Dillon Weston, Advisory Mycologists of the Southern and East Anglian Provinces respectively, and Mr. J. C. Mann, Assistant Director of the Norfolk Agricultural Education Department.

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References.

1. McAlpine, D. Take-all in wheat. *Jour. Dep. Agric. Vict.*, 1902, **1**, 74.
2. Samuel, G. Whiteheads or take-all in wheat. *J. Minist. Agric.*, 1937, **44**, 231.
3. Glynne, Mary D. Some new British records of fungi on wheat. *Trans. Brit. Mycol. Soc.*, 1936, **20**, 120.
4. Garrett, S. D. Soil conditions and the take-all disease of wheat. *Ann. appl. Biol.*, 1936, **23**, 667.
5. Spafford, W. J. Some diseases of wheat crops and their treatments. *Jour. Dep. Agric.* S. Aust., 1917, **20**, 531.
6. Griffiths, R. L. Take-all. Incidence and control on the lighter soils of the Mallee. *Jour. Dep. Agric.* S. Aust., 1933, **36**, 774.
7. Samuel, G., and Garrett, S. D. Ascospore discharge in *Ophiobolus graminis*, and its probable relation to the development of whiteheads in wheat. *Phytopathology*, 1933, **23**, 721.
8. Simmonds, P. M., and Sallans, B. J. Further studies on amputations of wheat roots in relation to diseases of the root system. *Sci. Agric.*, 1933, **13**, 439.

FARM ORGANIZATION ON THE BLACK FENS OF THE ISLE OF ELY.

THAT area of the east of England generally known as "the Fens" covers approximately 800,000 acres, and comprises the most fertile farming land of Britain. Most of it lies within a few feet of sea level,[1] and its productivity is due to and dependent on a complex and intensive system of artificial drainage. The district is one of considerable interest to geologists, archæologists, ethnologists, and naturalists, and a considerable library exists on its origins, historical associations, fauna and flora. Quoting largely from Evans' account in the *Natural History of Wicken Fen* (edited by J. Stanley Gardiner and A. G. Tansley), the fens were originally an estuary of which only The Wash now remains. Over this estuary layers of silt and peat were gradually built up in post-glacial times as a result of alternate marine and fresh-water conditions. Islands of Jurassic clay, sometimes capped with boulder clay or gravel, stand up above these deposits (*e.g.*, Ely). The south end of the fens was furthest from marine influences, and it is here that the black peats were formed from decayed fresh water marsh plants. To the north, where tidal conditions were prevalent, the deposits were chiefly silt (see Diagram I, p. 36).

The fens were inhabited in pre-Roman times, and recent air surveys have revealed much evidence of these early settlements. The period of the earliest attempts at artificial drainage is still a matter of speculation, but a secondary effect of these endeavours was to accentuate the silting up of the river mouths. Many of the river courses have been completely altered (in certain cases literally reversed) in consequence of such action. For example, the Ouse, which now discharges at King's Lynn, formerly debouched into the Wash at Wisbech (*i.e.*, Ousebeach). Nevertheless, the early works and subsequent action by local landowners did apparently result in some increase in the area of dry land up to the Middle Ages. The foundation of the modern systematic drainage was, however, not laid until the 17th Century, and the names prominently associated with the work are those of Francis, Earl of Bedford, and his son William (hence the "Old" and "New" Bedford Levels). Though the drainage of the fens may be said to have been completed by the middle of the 19th Century, great and ever pressing engineering problems have emerged. Aeration and cultivation have led to "wastage" in the peats, and the problem of getting the surface water from the land to the main drains, and thence to the open sea, has become ever more acute. Messrs.

[1] The average level of the silt soils is about 10 feet O.D.; the black peats are even lower, much being at or below sea level.

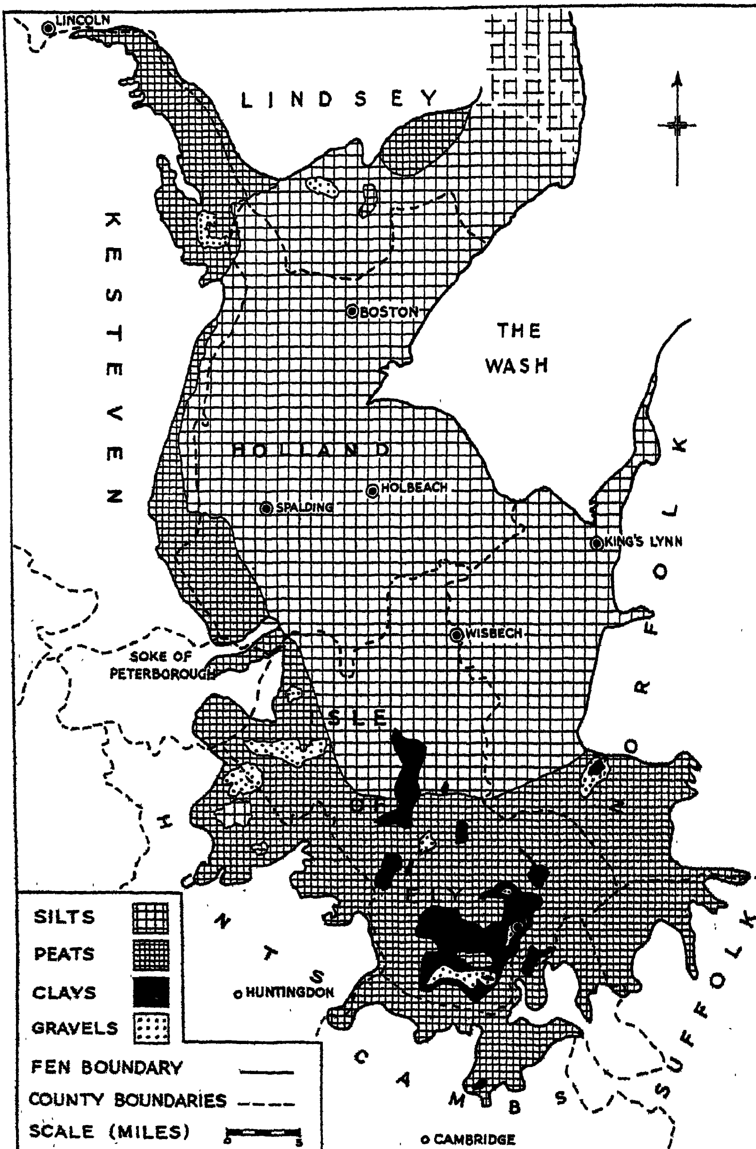

DIAGRAM I.—The Fens.

Godwin and Clifford[1] estimate that 200 years of drainage have lowered the peat surface by something of the order of 10 feet, while Fowler[2] states that before drainage the level of the fen peats was in many places no less than 16 feet higher than at present. The difficulties and dangers experienced so recently as March, 1937, emphasize the need for continual action and considerable expenditure if what has been so hardly won is to be held and maintained.

In reviewing modern farming organization in the Fens the silt soils and peat soils must be differentiated, as each has distinctive agricultural characteristics. The silts are a fine alluvial deposit varying from a light to a heavy texture according to the percentage of clay. In the Holland division of Lincoln, which consists mainly of silt, potatoes are the principal crop, covering a larger acreage than wheat and about four times the area of sugar beet. It is here also, round Spalding and Holbeach, that the bulb industry has been developed, while considerable acreages of fruit are grown, particularly round Wisbech. The black peats lie further from the sea (largely in the Isle of Ely) and consist of an accumulation of organic matter of varying depth overlying clay. But marked variations occur, and patches of "white fen" (*i.e.*, peat containing a large percentage of calcium in the form of foraminiferous and other shells), gravel fen (peat overlying gravel), clay outcrops, and "skirt" (*i.e.*, peat mixed with mineral particles, generally found on the outskirts of the fens), give rise to differences in cropping and crop yields. When the black peat overlies what is locally termed "blue buttery clay," this latter provides a medium, when it lies close enough to the surface, for improving the texture and cropping powers of the land. As described later (page 50), the process of "claying" is a costly one, but was frequently practised in the past when labour was cheap. The potato acreage on the peats is less than the wheat acreage, and probably less than the sugar beet area. Carrots and celery are important cash crops.

General Description of Farming on the Black Fens.

The present article is concerned with farm organization on the black peat soils. As might be expected, the type of farming to be found here is quite distinctive. The usual rotation is wheat-potatoes-sugar beet, with a few acres of oats, for horse-feed, taking any convenient place in the rotation. Celery is grown on "grounds" where the water level is sufficiently high, while peas for picking are chiefly found on the higher land where the clay outcrops. But very few fen farmers adhere strictly to any sort of a rotation, and the policy followed in 1936 appears to have

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[1] *Jour. Ecology*, XXII., No. 2.
[2] *Geograph. Jour.* LXXXI., No. 2.

been to grow as large an acreage of beet and potatoes as permitted by the Beet Factories and Potato Board, other crops being only a secondary consideration. Until recently beet was often taken year after year on the same field, frequently without any apparent adverse effect on yield. But the discovery of a few cases of sugar-beet eel-worm, often on fields cropped in this way, has led the Factories to prohibit the practice.

Considering the types of crops grown, the farmers are remarkably independent of imported casual labour, as the wives and families of regular employees assist with seasonal operations. Beet thinning, potato planting, and the beet and potato harvests are generally let out at "piece rates," and individual families may earn very substantial sums at certain times. In engaging regular workers, fen farmers are inclined to give preference to married men with large families in order to minimize their dependence on outside casual labour. Very little extra labour is required for the corn harvest, and much of the threshing is done at harvest time, as cartage is a difficult problem on most fen farms in the winter. In a dry season lorries can be run practically anywhere, and in the first few weeks of the beet season can be loaded in the field, and run direct to the beet factory. But heavy rain turns the fen "droves" into stretches of mud a foot or more deep, and then the only means of transport is the farm cart, usually with three horses hitched one before the other.

Tractors are now found on most fen farms of any size, and are hired on the small farms for the majority of winter ploughing. The advent of tractors is important, for unless the land can be quickly broken up and seeded after beet is cleared, the following crop of wheat is put in very late. As it is, wheat drilling can often not be done until February, and many farmers agree that in this case at least two sacks per acre are lost compared with autumn drilling. A large proportion of the smaller farms are still without a binder, but the crops, particularly of oats, are sometimes so bulky that the use of a binder would be impracticable. In these cases the crop is cut with a sail reaper or a grass cutter and tied by hand. Power binders are becoming more common on the larger farms.

Very few dairy cattle are to be found in this district, as the land is too valuable to be devoted to grass. The only grassland on most holdings is a small paddock near the farm buildings, but a considerable amount of grazing is derived from off-lying "washes."[1] The "banks and forelands" under the control

[1] A "wash" is a piece of land lying adjacent to a main river, and on to which flood water is allowed to overflow. Its purpose is to act as a reservoir at those times when the main outfalls to the sea cannot cope with the amount of water which is coming down from the higher lands. These washes cannot be cultivated owing to their frequent submersion, and provide a strong, luxuriant pasture during the summer months.

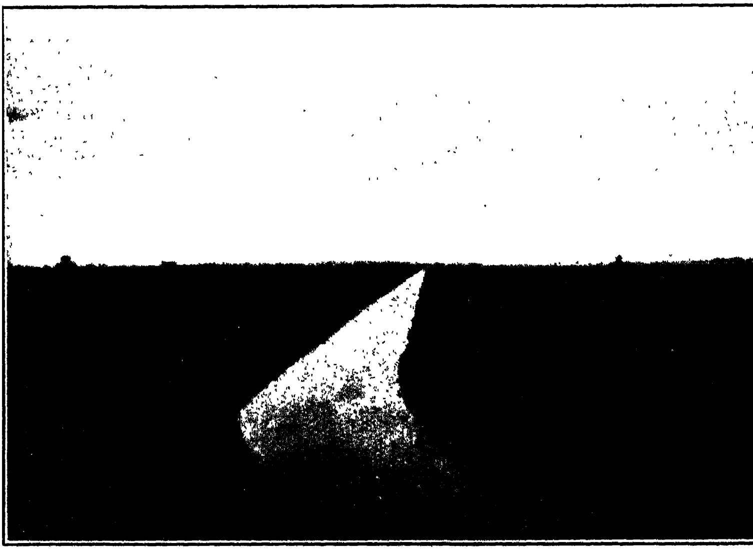

FIG. 1.—A typical Fenland landscape.

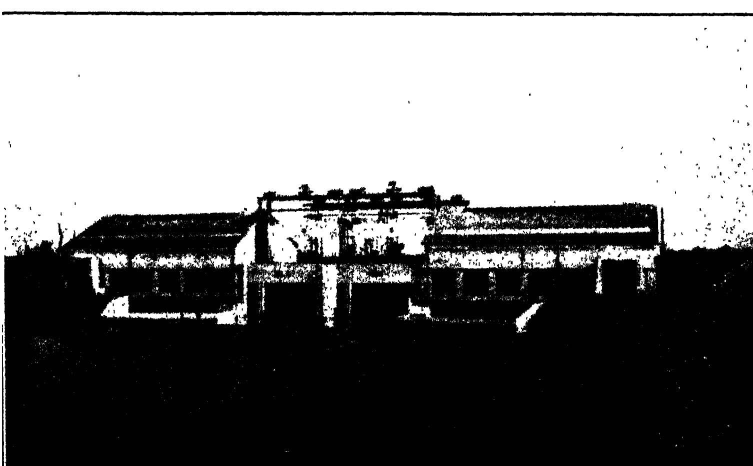

FIG. 2.—St. German's Pumping Station, near King's Lynn.

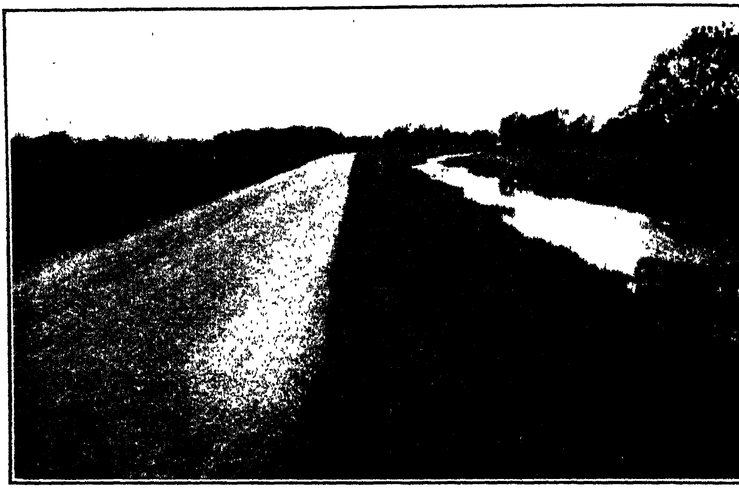

Fig. 3.—The Old West River—normal level.

Fig. 4.—The Old West River—flood level, March, 1937.

of Drainage Boards are generally let by auction and provide a certain amount of hay and pasture. Some bullocks are fattened on larger holdings, particularly where the farmer owns or is able to rent summer grazing on one of the numerous washes. The usual practice is to buy stores in the early spring, yard feed them for a few weeks before sending them to grass where they remain throughout the summer, and to bring them back to the yards in October for fattening off during the winter. The muck made by this means is used chiefly for the potato crop, which also gets a liberal dressing of artificials (see page 46).

Where no cattle are fattened, pigs are usually kept to tread down the straw, but buildings are generally extremely primitive. In fact, farm buildings in the fens proper are at best wood and corrugated iron structures, and, at worst, tumbledown frameworks of rough posts surmounted by a heap of straw. In contrast to the condition of the buildings, implements are generally modern and in good repair. Even on small holdings there is usually a good selection, and there appears to be more co-operation in pooling implements, horses, and labour than is usually the case amongst smallholders. Some attempt at intensive poultry keeping is made on an occasional farm, but as a rule this branch of the industry is represented by a few nondescript hens. Horse-breeding is still quite general, in spite of the introduction of tractors. Sheep are conspicuous by their absence, although a few are found on the "islands" rising above the fens proper.

Drainage on fenland farms would appear to be remarkably efficient, the most usual complaint being that the water level is kept too low during the summer months.[1] This is unavoidable in some cases, as the business of the Drainage Boards is to ensure that even the most low-lying land is kept free of water. Too efficient drainage can be counteracted by placing "overfalls" in the dykes, but this may only be done with the authority of the local Drainage Board. Surface waterlogging is a more serious threat to the fen crops than any defect in the main drainage system. Particularly on land where, owing to shrinkage of the peat, the underlying clay is now quite close to the surface,[2] pools of water are to be seen on low-lying parts of the fields after heavy rains. The crop will quickly "go off" in these patches

[1] Of the 50 farmers who provided records for the present investigation, 43 stated that the drainage on their farms was satisfactory, five that the water level was kept too low, and only two that their land was inadequately drained.

[2] Of the present sample of 50 farmers, no less than 38 stated that they had evidence of "shrinkage" of the peats on their own holdings. Of these, eight said that drainage had been adversely affected, eight said that crop yields had been decreased, while four thought that crop yields had been improved as a result of clay being ploughed up and mixed with the surface peat.

unless the surface water is removed, and this is generally done by ploughing or hand digging "water furrows" to the nearest ditch.

Scope of Present Investigation.

The parishes of Little Downham, Littleport, and Coveney were selected as the field of study on the grounds that they lay roughly in the centre of the peat-soil area, that they consisted mainly of black peat, and that they were easily accessible. These three parishes lie to the north and west of the city of Ely, cover an area of 30,000 acres, and include 522 "holdings" of 1 acre or more. The data were collected in the early months of 1937, and refer to the crops grown and harvested in 1936.

The first step in the investigation was to identify all the holdings of 1 acre and upwards included in the *Fourth of June Returns* of the Ministry of Agriculture. Of the 522 holdings, 262, or almost exactly half, were less than 20 acres in size. Of the 262 holdings under 20 acres, 129, or, again, roughly half, were "part-time" occupations. Thus it may be said that of the holdings included in the Ministry's annual statistics for these parishes, only three-quarters (393 out of 522) are full-time occupations, and one-quarter are rather of the nature of allotments occupied by persons primarily dependent on some other source of income. Of the occupiers of part-time holdings, 56 per cent. were stated to be agricultural workers, while 44 per cent. were village traders, craftsmen and others.

The second and principal stage of the investigation was to secure detailed records of farm organization from holdings of 20 acres and upwards, obtaining so far as possible a random sample. "Composite" farms (*i.e.*, a farm of which the occupier holds another farm or other farms elsewhere) were omitted from the selection on account of certain obvious technical difficulties which arise in recording such holdings. All together detailed records were obtained for 52 holdings, but of these two have not been included in the analyses for one reason or another. The records were obtained by a process of oral question and answer with each farmer, following the usual survey technique described in various Reports issued by the Cambridge University Farm Economics Branch. Of the 50 farms, detailed records for which are here used, 20 are between 20 and 50 acres in size, 14 between 50 and 100 acres, 8 between 100 and 150 acres, and 8 are over 150 acres. The "average" size of the whole 50 farms is 97 acres, and this compares with a figure of just over 100 acres for all holdings above 20 acres in the Isle of Ely. The method adopted of presenting the data in the ensuing pages is first to compare the organization of the 50 fen farms as a group with that of similar groups of farms in other districts of the Eastern

Counties in the same year,[1] and secondly to describe the organization of one or two individual fen farms.

Size of Business.

Measured in acres, the size of farms on the black fens tends to be rather smaller than on the adjacent uplands. Not only does the number of holdings under 20 acres represent a larger proportion of total holdings than in neighbouring counties (56 per cent. for the Isle of Ely as compared with 44 per cent. for Norfolk, Suffolk, Cambridgeshire, and Huntingdonshire), but the farms over 20 acres average 105 acres as compared with

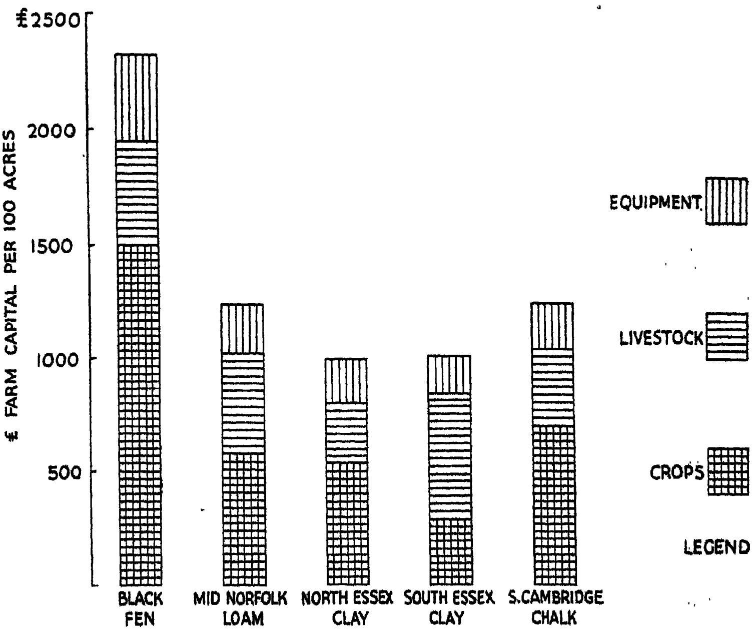

DIAGRAM II.—Farm Capital per 100 acres.
(Data refer to year 1936).

135 acres in the four counties already mentioned. Although the area of the farm units is comparatively small on the black fen, capitalization, employment, and output per 100 acres are each approximately twice as great as on adjacent upland farms. It is generally appreciated that these factors are a better index

[1] The other "type of farming" districts are (1) mid-Norfolk medium loams, (2) north Essex boulder clays, (3) south Essex London clays, and (4) south Cambridge chalk soils. In the various diagrams each of these districts is represented by 50 farms, and full details will be found in *Report* 24 of the Cambridge University Farm Economics Branch.

of the size of a farm business than is area, and on these criteria the size of fen farms is considerably larger than elsewhere.

The Michaelmas valuations of farm livestock, crops and equipment average £23½ per acre of crops and grass on the 50 farms included in the present sample. This figure compares with £10 to £12 in other parts of the eastern counties (see Diagram II.). On the fens the major investment is in crops (£15 per acre), live stock coming next at £4½ per acre, and equipment making up the balance of £3¾ per acre. One interesting feature of the fen data is that capital investment per acre appears to be comparatively constant whether the farm is large or small. This is in contrast to other districts, where capitalization per acre generally varies inversely with the area of farm, and suggests that, in the fens, large farms are organized as intensively as the small farms.

The number of manual workers[1] per 100 acres averages just over five on the fen farms as compared with roughly three in the neighbouring high-land districts. In regard to work horses, the relative position is somewhat similar, the fen farms having 4½ per 100 acres as compared with 2½ elsewhere. On the 50 farms included in the sample there were 26 tractors, or 1 tractor per 200 acres of farmed land. This compares with about 1 tractor per 300 acres on the high-lands. Details of the amount and composition of the gross sales from these fen farms will be given later, but here it may be said that they averaged nearly £20 per acre in 1936, or roughly double that from farms in other parts of the eastern counties.

Cropping.

Diagram III. illustrates the crop distribution in 1936 on the 50 farms comprising the fen sample. Although permanent pasture is shown as amounting to 20 per cent. of the farmed area, it must be appreciated that this is to a large extent composed of off-lying wash grazings, and as such is not strictly comparable with similar figures for other districts. Temporary grass represents less than 2 per cent. of the farmed land on the fen farms, and this gives some idea of the unusual nature of the rotations in this district. Wheat is the principal straw crop, accounting for one-quarter of the farmed area. The sugar beet acreage is almost as large as the wheat acreage, while potatoes are third in importance judged by area.[2] Potatoes and sugar beet together cover 40 per cent. of the farmed land, or exactly half the arable area. In contrast, the adjacent mid-Norfolk loam

[1] Casual workmen, women and boys are included here at an appropriate fraction of full-time adult employees.

[2] It is perhaps worth repeating that on the silt soils to the north the acreage under potatoes is much larger than that under sugar beet, and that herein lies perhaps the main difference in the cropping of the silts and black soils of the fens.

farms have less than 10 per cent. of their arable area in these two crops. "Other cereals" consist mainly of oats, while among "other crops" are included celery, carrots, chicory, asparagus and mustard seed.

Considering the farmed land as a whole, almost exactly two-thirds are devoted to "cash" crops on the black fens, a figure which compares with approximately 40 per cent. for other parts of the eastern counties. Not only is the acreage of "cash" crops relatively much larger in the fens than elsewhere, but the types of crop here grown are mainly those which yield high money receipts per acre.

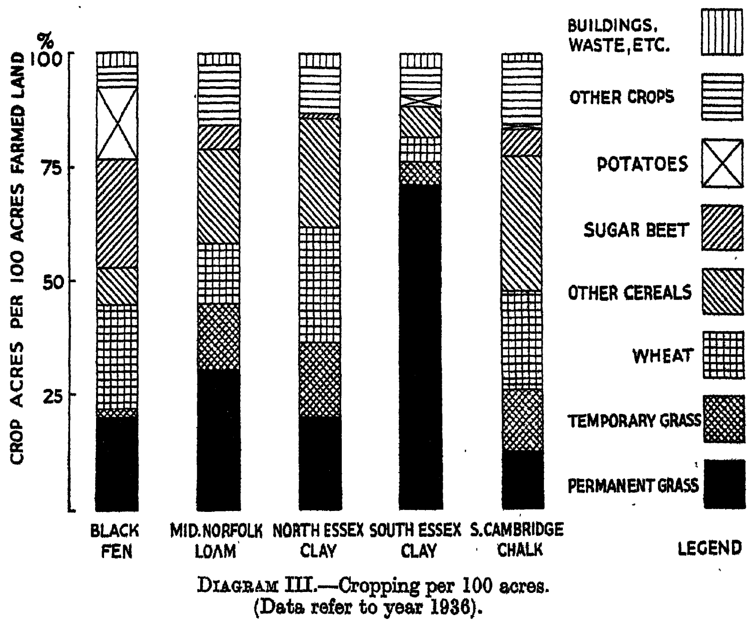

DIAGRAM III.—Cropping per 100 acres.
(Data refer to year 1936).

Some idea of the productivity of the fen soil may be obtained by considering yield per acre on the 50 farms comprising the present sample. The average yields for the three chief crops in 1936 were :—Wheat, 5 qrs. per acre ; potatoes, 7 tons per acre ; sugar beet, 12½ tons per acre. Generalizing broadly, it may be said that these figures indicate yields per acre on the black fens to be roughly one-third greater than on the neighbouring uplands. Incidentally, the 1936 season was generally conceded to be a bad one for potatoes on the peat soils. On one of the larger farms included in the present sample, 50 acres of potatoes yielded 8 tons per acre in 1936 as compared with 14 tons for a similar area in 1935. As with all other measures of farm production, the range

in crop yield per acre between individual fen farms is wide, wheat varying from 2½ qrs. to 8 qrs., potatoes from 3 tons to 11 tons, and sugar beet from 9 tons to 16 tons. The higher figures quoted are by no means records for the district.

Gross Income.

The gross income from the 50 fen farms from which records were obtained averaged nearly £20 per acre and, of this total, crops contributed three-quarters, or approximately £15. Both the absolute and relative importance of crops on the fens is thus very much greater than in other parts of the eastern counties where crop sales in 1936 may have averaged £4 per acre of farmed

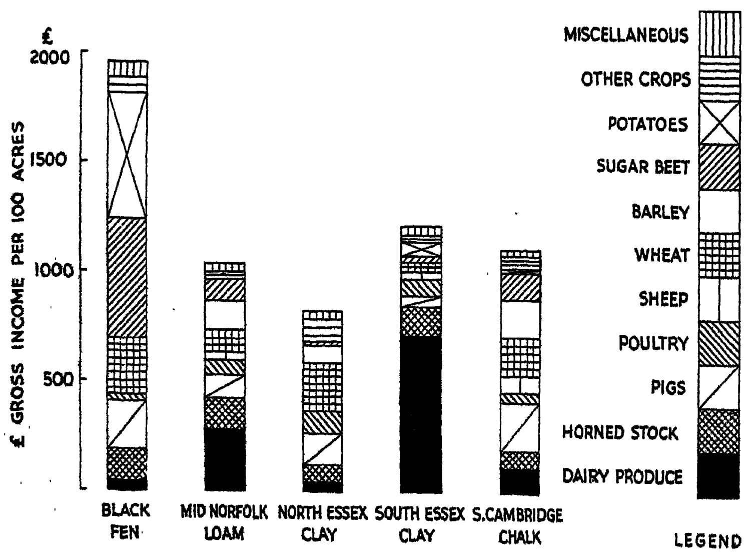

DIAGRAM IV.—Gross income per 100 acres.
(Data refer to year 1936).

land, and certainly less than half the gross income (see Diagram IV.). Sugar beet and potatoes are the two major items of revenue on the black soils, and together account for more than half the total receipts. Wheat comes third in importance, but the income from this source is less than half that from sugar beet. Pigs are the major live-stock enterprise, and sales of these amounted to nearly as much as the receipts from wheat. Cattle are the second most important live-stock department, and, collectively, cattle and pigs account for four-fifths of the total live-stock sales. Although horse-breeding is traditionally associated with the fens, sales of horses amounted to only a

little over 1 per cent. of gross incomes on the 50 farms covered by the investigation. It will be observed from Diagram IV. that dairy produce, poultry, sheep and barley are all inconspicuous items in the black fen district.

Gross Expenses.

Expenses on the fen farms amounted to nearly £15 per acre, which is rather more than 50 per cent. higher than on neighbouring upland districts (see Diagram V.). The principal item of cost is labour, which, including family labour other than that of the occupier, averaged £4½ per acre. Rent is the second most

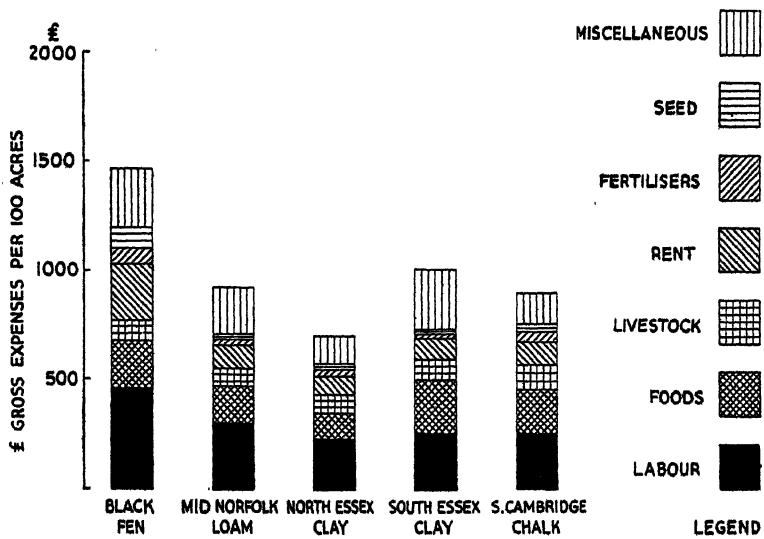

Diagram V.—Gross expenses per 100 acres.
(Data refer to year 1936).

important item of cost and, including the tenant's share of drainage rates, averaged 50*s*. per acre. These figures compare with, roughly, 50*s*. per acre for labour and 20*s*. per acre for rent in adjacent districts. Rent represents a substantially higher proportion of gross expenses in the fens than in other districts of the eastern counties (approximately 18 per cent. as compared with 11 per cent.), but the incidence of labour, at roughly 30 per cent. of gross costs, corresponds closely. Expenditure on feeding stuffs is at first sight remarkably high in the fens, amounting to rather over £2 per acre. Indeed, more is spent on purchased feeding stuffs here than in the nearby mid-Norfolk district, where the live-stock output per acre is very much larger.

To put this in another way, every £100 worth of live stock produced in the fens consumed about £60 worth of purchased foods, whereas in mid-Norfolk only a little over £30 worth of purchased foods was required. The explanation is, of course, that in the fens a much larger proportion of the farm is devoted to cash crops, and a much smaller quantity of fodder crops is grown. It is true that large quantities of sugar-beet tops are available, but there are no sheep to fold them. Further, pigs are relatively of greater importance in the fens than elsewhere (pig sales account for half total live-stock sales), and these animals require more concentrates than do cattle or sheep.

Expenditure on fertilizers in the fens averaged about 15*s.* per acre per annum over the whole farm. This is roughly three times as much as is spent in other districts of the eastern counties. As has already been stated, manures are applied largely to the potato crop. This is illustrated in Table I., from which it will be seen that three-quarters of the potato acreage gets an average dressing of 17 loads of dung per acre, over two-thirds have 8 cwt. of proprietary or other mixtures, while one-quarter has 7 cwt. of phosphatic fertilizers (mainly as superphosphate). Relatively little straight potassic fertilizer is used for any crop, although potash is included in many of the proprietary and other ready-mixed fertilizers.

TABLE I.

DISTRIBUTION OF MANURING ON THREE PRINCIPAL CROPS ON BLACK FENS.

		Potatoes	Sugar Beet	Wheat
Dung—				
Per cent. crop area dressed .	%	75	19	3
Av. dressing per acre .	. loads	17	13	11
Ready-Mixed Fertilizers—				
Per cent. crop area dressed .	%	68	62	2
Av. dressing per acre .	. cwt.	8	5	1½
Phosphatic Fertilizers—				
Per cent. crop area dressed .	%	25	34	4
Av. dressing per acre .	. cwt.	7	5	3
Nitrogenous Fertilizers—				
Per cent. crop area dressed .	%	14	5	17
Av. dressing per acre .	. cwt.	2	2	1

Expenditure on seed is also high in the fens (averaging nearly 20*s*. per acre), mainly as a result of the large acreage of potatoes, and the need for importing fresh seed potatoes from Scotland approximately every alternate year.

Gross Output.

Gross output is a measure of the value of the goods actually produced, and is generally calculated by the formula: sales *minus* purchases of live stock *plus* or *minus* change in valuation. In the present instance purchases of feeding-stuffs have also been deducted from sales in order to arrive more closely at the productivity of the farms, and to secure closer comparison between districts in which dependence on purchased feeding-stuffs is variable.

The value of the gross output per 100 acres on the black fens is £1,650, or approximately double that on the four other districts in the eastern counties with which comparisons have been made (see Table II.). This relatively large output illustrates the

TABLE II.

GROSS OUTPUT* PER 100 ACRES, PER MANUAL WORKER, AND PER £100 FARM CAPITAL.

District	Number of farms in group	Average size of farm	Gross Output		
			Per 100 acres	Per worker	Per £100 farm capital
	No.	Acres	£	£	£
Black fens	50	97	1,650	325	71
Mid-Norfolk loams	50	129	775	215	63
North Essex arable clays	50	165	625	220	62
South Essex pasture clays	50	155	875	315	86
South Cambs. chalks	50	189	800	270	63

* Gross Output = Sales *minus* purchases of live stock and feeding-stuffs *plus* or *minus* change in farm valuations.

intensity of the production in the fens. It is achieved partly by concentrating on "high-value" crops (*e.g.*, potatoes, sugar beet, celery) and partly by high yields per acre. The latter are in turn due largely to the natural fertility of the soil, but liberal applications of fertilizers and good management contribute to the result. Output per worker is also relatively high in the fens, and the only other district where similar labour efficiency occurs is the south Essex London clays, where milk production from grass, for the London market, is the chief enterprise (see Diagrams III. and IV.). Lastly, the rate of capital turnover (as measured by the ratio of gross output to farm capital) is comparatively high in the fens. It may thus fairly be said that the three factors in production—land, labour and capital—are employed with great effectiveness in this area. The responsibilities and rewards of management are on a similar scale.

Some Individual Farms.

The foregoing pages have been occupied largely by generalizations, and it may therefore be of interest here briefly to describe the organization of one or two individual farms, to give, as Pooh-Bah said, " verisimilitude to an otherwise bald and unconvincing narrative."

Farm A extends to something over 300 acres, of which about 220 acres are arable and the balance off-lying pasture. The cropping in 1936 comprised 60 acres of sugar beet, 55 acres of potatoes, 85 acres of wheat, 7 acres of celery, 5 acres of picking peas, 3 acres of asparagus, 3 acres of lucerne, and 2 acres of mangolds. Thus, 215 acres out of the 220 acres of arable were under cash crops. Sales of crops totalled about £6,000 from the 215 acres, or an average of nearly £30 per crop acre.

In preparing the land for sugar beet, ploughing is generally done to about 14 inches depth with a subsoiler going some 6 inches deeper. This deep cultivation is considered to help surface drainage. The varieties grown in 1936 were Marsters, Johnson's Perfection and Kuhn P., and the crop was dressed with a mixed fertilizer at the rate of 5½ cwt. per acre. The 60 acres of beet gave an average yield of 15½ tons per acre, with a sugar content of about 15½ per cent.

The varieties of potatoes grown (in order of earliness) are Eclipse, Doon Star, Red King, King Edward, and Majestic. Preparation for this crop commences with deep ploughing (up to 19 inches) with a Ransome No. 3 " Unitrac Major " in December and January. Manuring for 1936 was at the rate of 15 loads of dung per acre plus 1 cwt. of Sulphate of Ammonia, 8 cwt. of 35 per cent. Superphosphate, and 1 cwt of Sulphate of Potash. The seed is not chitted on this farm, although the occupier is considering building a glass chitting house to get the two of three weeks earlier maturity which this practice provides. During June and July the crop is " dusted " three times (four times if there are any early signs of blight) with 25 lb. per acre of a proprietary fungicide. The 1936 crop lifted badly, yielding only about 7–8 tons per acre, as compared with a normal of 12–14 tons.

The varieties of wheat grown are Little Joss, Square Head II., Red Marvel, Renown, and A.1 for late spring drilling. No dung or fertilizer was applied in 1936, and the crop averaged 6 qrs. per acre.

Celery, although covering only a small acreage, contributes substantially to the gross income. If the plants are grown from seed they must be sown under glass in February and pricked out in a sheltered spot in March. It is, however, more common for growers to buy seedlings which may cost from 4*s*. to 5*s*. per 1,000. In the field the rows are set at 4½ to 5 feet apart. The

FIG. 5.—Preparing ground for celery.

FIG. 6.—A good crop of chitted Eclipse, photographed on June 1st.

crop is generally dunged heavily (20–30 loads per acre) and, in addition, fertilizers at the rate of about 10 cwt. per acre are scattered by hand along the bottoms of the drills. The fertilizers are mixed with the soil by subsequent scuffling and rolling. A special tool called a "butterfly"—rather like a miniature snow-plough—splits back the loose earth after the scuffle, and consolidates the bottom of the drill. Into this firm drill-bottom the seedling plants are dibbled about 4 inches apart, or at the rate of some 25,000 per acre. This planting out takes place towards the end of May, and from then until July hoeing is done up the drills by tractor and between the plants with a special hand hoe. Towards the end of July or in early August "earthing up" is commenced with a small "butterfly," and this continues into September, when the tops of the ridges may be 3–4 feet above the intervening furrows. Harvesting takes place from September onwards, the plants being hand dug with a special type of spade.

Reference has been made in the earlier pages of this article to the general excellence of field equipment on fen farms. Farm A provides an illustration of the standards which may be achieved in this district, for in addition to the complement of tumbrils, harrows, ploughs, etc., usually found on farms the occupier possesses :—

1 40 h.p. Caterpillar Tractor
1 21-h.p. Allis Chalmers Row Crop Tractor (with full Tool-bar equipment)
1 2½-h.p. Hamworth Paraffin engine for barn machinery
1 4½-h.p. Bamford Paraffin engine for mill and chaff-box
1 Threshing Drum
1 Cooke "National" Elevator
1 3-furrow tractor plough
1 3-furrow ridging plough
1 2-furrow plough
1 Ransome No. 3 "Unitrac" plough
1 Tractor cultivator
1 Power binder
1 Bamford tractor grass-mower
1 Reaper
1 3-row Potato marker
1 3-row Potato setter
1 7-row Potato duster
1 Potato digger
1 Celery planting plough
1 Celery scuffle
1 Celery moulding plough
1 Corn drill
1 Sugar-beet drill
1 Manure distributor
1 Blackstone horse rake
1 10-row Wheat horse hoe
2 2-row Beet horse hoes

Not only is the equipment ample and modern, but it is kept in first-class condition. As a result of this mechanization the number of work horses has been reduced by 10 during the last five years, and the amount and quality of the work done is, if anything, greater now than formerly. The number of employees has also been reduced.

The live stock comprise half-a-dozen cows on which some 15–20 calves are reared. These are kept on the off-lying pasture during summer, but are brought into yards in winter, and are generally sold fat at 2–3 years old. Twenty sows are kept, and

the progeny fattened for pork or bacon. The principal outlay on feeding-stuffs is for pigs, but some horse-feed and cattle-cake is also purchased.

The number of regular employees was about 15 in 1936, and the labour bill was over £1,600. The practice, common locally, for the families of regular employees to assist at seasonal operations makes it particularly difficult to estimate earnings per worker. For example, the occupier of Farm A considers that the wives of six of his regular employees undertook farm work for 7–8 months in the year, while children and other members of men's families were also at work for short periods. As the total weekly earnings of a family are paid to the head of the household, and as much of the work is done at piece rates, details of actual employment are impossible to determine accurately.

Farm B is about 120 acres. Including the occupier, it provides employment for four regular workers, while roughly £100 extra is spent on casual labour. There are six work horses, a tractor, and a motor lorry. The rent is £2 per acre, while drainage rates add a further 8*s*. per acre to overhead costs.

In 1936 the cash crops comprised 35 acres of wheat (yielding 5 qrs. per acre), 50 acres of sugar beet (yielding 15 tons per acre), and 10 acres of potatoes (yielding 10 tons per acre). Crop sales totalled more than £2,000, or an average of over £20 per acre. The fodder crops were 5 acres of oats (yielding 9 qrs. per acre), 3 acres of mangolds (yielding 30 tons per acre), and 3 acres of ryegrass (yielding 2½ tons of hay per acre). In addition, there were about 15 acres of permanent pasture. More than £100 was spent on fertilizers, the sugar beet having 6 cwt. per acre of a proprietary mixture costing £5½ per ton, and the wheat, potatoes and mangolds having 3 cwt. per acre of superphosphate. Further, 10 acres of peat were "clayed" at a cost of £11 per acre. This operation involves digging narrow ditches across the field down to the underlying clay, throwing the clay out and spreading it evenly between the ditches, and then filling up the excavations to make all reasonably level again.

About a dozen bullocks, purchased as stores in the previous year, were finished off and sold fat, while a score of yearling stores were bought for rearing and subsequent fattening. Half-a-dozen sows were also kept and the progeny sold as stores or pork. Three foals were bred during the year, and one cow was kept to supply the household with milk. The total value of the live stock "output" for the year was £450, involving an expenditure of £300 on purchased feeding-stuffs.

Farm C is a small holding of about 30 acres. Rent and drainage rates approximate £3 per acre. There is only one regular employee, but both the occupier and his wife are energetic

and hard working, while £15–£20 is spent on casual labour at the potato harvest. There are three good work horses, from one of which a foal was bred during the year.

In 1936, the cash crops were 5 acres of wheat (yielding nearly 8 qrs. per acre), 12 acres of sugar beet (yielding 15 tons per acre), and 6 acres of potatoes (yielding 11 tons per acre). Crop sales amounted to over £700. The fodder crops comprised 2 acres of oats (yielding 11 qrs. per acre), 1 acre of lucerne (of which half was cut green and half for hay), and half-an-acre of mangolds. There were four acres of permanent grass, of which 2 acres were cut for hay.

Scottish seed was bought for half the potato acreage, and cost £6 per ton. Sugar-beet seed was drilled at the rate of 20 lb. per acre. The potatoes were dunged with 25 loads per acre, while all the potatoes and sugar beet received a dressing of 11 cwt. per acre of a ready-mixed fertilizer costing £5 per ton.

The live stock consisted of half-a-dozen sows from which the progeny was sold mainly at bacon weight, but partly as stores. There were also about two hundred poultry, from which sales of eggs amounted to nearly £100. Expenditure on feeding-stuffs approximated £170.

Acknowledgments.

The field work for this study was done by Mr. R. F. Edwards. Thanks are primarily due to the 50 fenland farmers who kindly provided the details on which the body of this article is based. It is a pleasure also to acknowledge gratefully the assistance received from Major Gordon Fowler, of the Ely Beet Sugar Factory, the Chief Constable of the Isle of Ely, and Mr. F. Hanley, of the Cambridge School of Agriculture.

Summary.

The Fen district round The Wash extends to about 800,000 acres, and comprises the richest farming land in Britain. The soil on more than half of this area is a silt deposit, while rather less than half is a form of peat derived from decayed fresh water plants. The silts and peats must be clearly distinguished, as they have different agricultural characteristics.

The present study deals with farm organization on the peat soils in 1936. Capitalization, employment and output per acre are here on a much more intensive scale than in neighbouring upland districts. The capital value of farm live stock, crops and equipment averages nearly £25 per acre, sales approximate £20 per acre, while employment is at the rate of five workers per 100 acres.

Crops are the principal source of revenue, representing nearly 80 per cent. of gross incomes. The principal cash crops are

sugar beet, potatoes and wheat. Sugar beet and potatoes together account for half the arable area and represent nearly 60 per cent. of gross incomes.

The output per worker is relatively high, partly on account of the types of crop grown, and partly as a result of mechanization and good management. Dependence on imported casual labour is less marked than might be expected, as the wives and families of regular employees undertake much of the seasonal operations.

Drainage, although an ever present problem, appears to be generally satisfactory and efficient.

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ARE CULTIVATION STANDARDS WASTEFULLY HIGH?

INTRODUCTION.

THIS article is both a challenge and an appeal for assistance. One of the firmly rooted traditions of British agriculture is the virtue of thorough cultivation; indeed the majority of farmers believe that crops will suffer and yields drop by just the extent that the soil tilth falls short of perfection. The tradition was established long before the days of agricultural science and, possibly because its truth seemed self-evident, it was never critically examined.

One purpose of agricultural science is to examine traditional beliefs and to remove the husk of unessentials and inaccuracies that often covers the grain of truth. The marked economic changes in agriculture are ample further justification, if any be needed, for a critical study of the alleged close dependence of crop growth and yields on tilth, for cultivation costs are now the heaviest single item in the arable farmer's budget.

In the days of exclusively horse cultivation, ample labour supply and low wages, soil cultivation was in a sense a spare-time occupation, in spite of the importance attached to it. It cost little if anything more to use the men and teams for a cultivation than to let them stand idle, for horses had to be fed and wages paid in any case. This, and the belief in the virtues of cultivation, worked in well together, and often led to the state of affairs described by a well-known Sussex farmer: "I have here the tillage book made when my father entered my present farm in 1870; there were 4 ploughings, 25 drags, 10 small harrows and 8 rolls to get a tilth for swedes; and this was in a dry season."[1]

Although the example is tinged with over-enthusiasm, it undoubtedly shows the outlook of the time, which has persisted.

But, unlike the horse, the tractor need not cost anything when it is idle; hence it is of great importance to know whether cultivations in excess of some minimum are worth while. In order to answer this question it is necessary to examine separately the effects of various standard cultivation operations on plant growth and yield, and also to investigate newer methods, *e.g.* rotary tillage, that claim to produce a tilth more quickly or more cheaply.

The experiments discussed below began in 1926, and cover a variety of seasons, crops, and cultivations. They were begun in the full belief that they would provide quantitative data amply confirming the traditional view of cultivation. The results,

[1] Rothamsted Conferences V: *The Art and Science of Cultivation.*

however, have forced us to conclude that yields are not markedly influenced by cultivation; that the number and type of essential cultivations for seed-bed preparation and during crop growth can be reduced without detriment; and that a temporary reduction of cultivations even below this minimum can be made without appreciable loss.

That is the challenge: we believe that the present accepted standards of good cultivation are wastefully high. The appeal is for further work on other types of soil, for our experiments have been done mainly at Rothamsted. Recently the Cambridge School of Agriculture has started experiments whose results are closely in accord with our own. The practical and economic consequences of scaling down the standard of cultivation are of such obvious importance as to afford ample incentive to experimenters elsewhere.

Our experiments fall into two groups: the first deals with familiar standard operations, ranging from subsoiling to inter-row cultivation of root crops; and the second with the depth of tillage and with rotary cultivation. All the experiments were done at Rothamsted unless otherwise stated.

The Effects of Standard Operations.

1. *Subsoiling.*—This operation is known to vary in its effect from one soil type to another, but no clear generalization has emerged beyond its value in breaking up pans. There are many other soil types with clayey subsoils for which subsoiling is stated to be desirable to break up the compressed layer, or plough-sole, formed by using the plough over a number of years at the same working depth. The Rothamsted soil falls into this category. The advent of the tractor has undoubtedly led to an increase in subsoiling, especially for crops like sugar beet. Two experiments on this crop were made. In 1928 a subsoiler working to a depth of 14 inches behind the plough was used. An insignificant increase of less than 1 cwt. of roots per acre, on a mean yield of 9·15 tons, was obtained. In 1931 a more thorough test was made again on sugar beet; the subsoil was hand-dug with forks and very thoroughly broken up. The mean yield of roots was 12·66 tons per acre, and the labour of subsoiling produced a small decrease of nearly 5 cwt. per acre. These two experiments strongly suggest that the cost of subsoiling should not be incurred unless experiments on the land in question have shown that an extra yield is likely to be secured, and that the increased cash return will pay for the cost of the work.

2. *Extra ploughing.*—Normally the preparation for root crops includes both autumn and spring ploughing. If bad weather prevents the autumn ploughing, some apprehension is felt as to the quality of the spring seed-bed. It is therefore of practical

interest to examine the effect of deliberately withholding either the autumn or spring ploughing. In 1934 two experiments were made: one on potatoes in which autumn *plus* spring ploughing were compared with only spring ploughing, and the other on sugar beet, comparing autumn *plus* spring ploughings with only autumn ploughing. In each case the double ploughing produced a slight (but not significant) increase of yield over the single ploughing: for potatoes an increase of 5 cwt. on a mean yield of 11·43 tons, and for sugar beet an increase of 7 cwt. on a mean yield of 15·36 tons, and neither increase paid for the extra cost of the double ploughing.

3. *Consolidation of seed-bed.*—Occasionally a cereal crop shows strips of taller growth running across the field, marking the path of the tractor wheels. If the extra consolidation is the cause, there is no reason why the effect should be confined to cereals, and it may be that the obvious difficulty of visually observing it in root crops is the reason why it has not been reported. Experiments in 1934 and 1935 were made to test the effect of heavily rolling a sugar-beet seed-bed, because of an accidental observation that improved germination and early growth of sugar beet occurred on a portion of a field that had become heavily consolidated in the previous winter by the passage of farm carts. The number of plants per acre was counted to see if improved germination resulted on the plots with consolidated seed-beds. In the 1934 experiment heavy rolling produced a significant increase of three thousand plants per acre, above the mean of 47·9 thousand; but the final yield of roots was 9 cwt. less than the mean of 14·03 tons per acre. In the 1935 experiment the average values for plant numbers and yields of roots were respectively 29·4 thousand and 11·57 tons per acre, and heavy rolling produced small insignificant reductions both in plant numbers and in yields of roots.

In neither year, therefore, was there any ultimate gain from the extra operation.

4. *Intensive inter-row cultivation of root crops.*—A frequent stirring of the surface soil is commonly assumed to have beneficial results, in addition to the direct effects of weed eradication and mulch formation. The root-break affords the only opportunity for intensive inter-row cultivation, so it is of interest to see whether the extra cultivations beyond the minimum necessary to keep down weeds and to break any crust or "cap" are worth while. Five experiments were made; one on kale and three on sugar beet at Rothamsted (heavy loam), and one on sugar beet at Woburn (sandy soil). In the "ordinary" cultivations, hand or light horse-hoeing, and motor hoeing, sufficient to keep down weeds were given; on the "intensive" cultivation plots further hoeings were given after singling, at approximately 10-day

intervals, depending on the weather conditions. The results of the experiments are given in Table I.

TABLE I.

	Mean yield.	Increase (+) or decrease (−) from intensive hoeing.		Number of hoeings.	
		Mean.	Significant difference.	Ordinary.	Intensive.
Sugar Beet. Roots in tons per acre.					
1932, Rothamsted .	13·5	−1·03	0·28	3	8
1934, Rothamsted .	15·4	−1·79	0·55	2	8
1935, Rothamsted .	11·6	+0·25	0·41	3	8
1932, Woburn . .	11·9	−0·23	0·42	5	8
Kale. Green weight in tons per acre.					
1932, Rothamsted .	25·5	−1·84	0·68	2	7

The results are striking. Intensive hoeing gave an increased yield only in the 1935 experiment, and the increase (0·25 ton) was well below significance (0·42 ton). The remaining four experiments all showed decreases, which in three cases were so great as to be undoubtedly real effects. In other words, the result of the extra labour and cost of intensive hoeing was a marked reduction in yield.

A possible criticism of these experiments is that the hoeing damaged shallow feeding roots and broke a number of leaves. But such criticism, if true, could not be confined only to these experiments but would apply to intensive cultivation in general. Indeed, it is possible that any benefit to soil fertility from extra surface cultivations in ordinary farm conditions is more than offset by the unavoidable damage to the plants. Whatever the explanation, the fact remains that no benefit—and usually a definite reduction in yield—was obtained by giving extra cultivations.

5. *Rolling and Harrowing of Cereals.*—Experiments were made in 1931 and 1933 on rolling alone, harrowing alone, and both, compared with controls in which both operations were omitted. The results are summarized in Table II.

TABLE II.

Wheat.—Cwt. per acre.

	Mean yield.	Increase (+) or decrease (—) over control.			
		Harrowing.	Rolling.	Harrowing and rolling.	Significant difference.
1931—Grain .	15·8	+1·8	+0·8	+2·1	1·2
Straw .	39·1	−0·2	+3·0	−0·7	2·7
1933—Grain .	23·3	+0·3	+0·3	+1·4	2·2
Straw .	34·0	−0·7	+1·8	−0·6	4·3

The table shows that the same results were obtained in each experiment although they were separated by two years and done in different fields. So far as the significance of the results is concerned comparison of the magnitude of the increases and decreases with the figures for "significant difference" shows that the 1931 results were the better. The conclusions from the table are that harrowing and rolling done together give an increased yield of grain and a small decrease in the straw; harrowing alone produces a similar but less marked effect; rolling alone slightly increases the grain yield but appreciably increases the straw yield. It is interesting to note that the result of the combined operation is not the arithmetical sum of the separate effects. For example, the increased straw yield, due to rolling alone, is replaced by a depression in straw yield when both rolling and harrowing are given. Nor, indeed, should such a simple additive effect be expected, except on a theory so simplified as to have little relation to reality.

Rotary Cultivation and Depth of Tillage.

With the ordinary range of implements, whether horse or tractor drawn, the preparation for the seed-bed consists in working down the weathered furrow-slice with harrows alone, or with a cultivator followed by harrows, if the land is insufficiently weathered. It is only in very favourable circumstances that the winter weathering of medium and heavy soils is such that an excellent seed-bed is secured by a single stirring of the top layers of the soil; in most seasons the disruptive effect of the implements must supplement incomplete natural weathering, and in especially adverse conditions one may have to be content with a "forced" tilth.

The speed and power of a tractor enable full use to be made of short spells of favourable weather, and attention has recently been given to the use of a tractor-drawn cultivator with suitable tines, which may be capable of replacing—not displacing—the plough in certain conditions and thus still further speed up the work. But its use would appear to be limited. Although it will break up the soil better than the plough will, and so hasten seed-bed formation, it cannot bury weeds or manure.

Another type of implement, designed solely for use with the internal combustion engine, is the rotary cultivator. There are two types: in one the tines are attached to a vertical shaft, and in the other to a horizontal shaft. An example of the former is the Gyrotiller—a large machine—that has been used in the Cambridge experiments. The Rototiller is a typical example of the latter type. It is a much smaller machine, extensively used in market gardens and orchards, and it has been employed in all the Rothamsted experiments. As the tines are attached to

a horizontal shaft they enter and leave the ground in a vertical plane, and thus mix the soil to the full depth of cultivation. The machine cannot bury weeds or farmyard manure, as the plough does by a bodily inversion of the furrow slice, but it will effect a certain degree of incorporation of such material with the soil.[1] In its present stage of development, therefore, it could not completely replace the plough, but there is clearly a need for a long series of experiments with the machine to see how far its disabilities are apparent or real, and to what extent the yields and the general state of the soil are affected in comparison with ordinary ploughing.

Preliminary experiments were begun at Rothamsted in 1926; they were developed in the following years until in 1934 sufficient experience had been gained to justify a detailed trial which will last for at least 12 years on a three-course rotation of roots, barley, and wheat. The area is divided into three main blocks, so each crop is grown every year. The tillage implements under comparison are plough, tractor-drawn cultivator and Rototiller. On some of the plots the allotted cultivation is continued unchanged, so that any cumulative effects due to the exclusive use of the cultivator, or the rotary cultivator, instead of the plough can be measured both for deep and shallow work. In some of the earlier experiments the effect of different depths of cultivation, both for plough and Rototiller, was also investigated. The "shallow" depth was about 4 inches and the "deep" depth was about 8 inches. To attain the 8-inch depth, however, with the cultivator or Rototiller, it is usually necessary to go over the land twice.

A general discussion of the results obtained since 1926 follows. The discussion has been drastically condensed here, because a full account of the work will appear shortly in the *Journal of Agricultural Science.*

The early experiments in 1926–28–29 compared ploughing with Rototiller cultivation of a stale furrow in spring. In 1930 both implements were used directly for mangold seed-bed preparation on land that had carried swedes the previous year. In 1931 an autumn seed-bed for winter wheat was prepared by both implements directly from a winter-oats stubble. In 1932 both shallow and deep cultivations for a winter wheat seed-bed were compared. In 1933 preparations were made for the long range experiment already mentioned. Table III. gives a summary of the results of the earlier experiments.

In each experiment there was less yield on the Rototilled plots, and although a comparison of the reductions with the

[1] The Gyrotiller design does offer the possibility of burying material, as the action of the tines on the soil somewhat resembles that of a plough with a sharply concave mouldboard.

corresponding significant differences shows that they were not significant—except in 1926 and 1928, before we had had experience in using the implement—they are all in the same direction.

TABLE III.

Decrease in yield for Rototillage compared with Plough and Harrow.

Year.	Crop.	Mean Yield.	Reduction with Rototillage.	Significant difference.
1926	Swedes, roots in tons, per. acre.	10·2	1·65	1·46
1928	,, ,, ,, ,,	21·4	2·55	1·58
1930	Mangolds ,, ,, ,,	29·0	3·78	7·55
1929	Barley, grain in cwt. per. acre.	30·2	0·6	1·76
1931	Wheat, ,, ,, ,,	15·1	1·5	1·72

The later experiments, with very few exceptions, show the same effect, and there can be no reasonable doubt that, under conditions at Rothamsted, crop yields are slightly less with Rototillage than with the normal implements. If the over-all costs of rotary cultivation are only slightly less than those for the normal implements, the net return would be about the same in each case.

The later experiments allow the effects of deep and shallow tillage with the plough, cultivator, and Rototiller to be compared. For wheat, deep ploughing gave no advantage over shallow; both the cultivator and the Rototiller gave about 1½ cwt. more grain and 1½ cwt. more straw for deep working compared with shallow. With barley, deep ploughing increased the straw yield only by about 1·5 cwt.; with the other two implements used, deep tillage gave an increase of nearly 2 cwt. of grain and 1½ cwt. of straw over shallow tillage. With mangolds, deep tillage proved beneficial, the average increases in tons per acre, over shallow, being 1 ton for the plough and about 2½ tons for the cultivator and the Rototiller.

It is as yet too early to say whether the cultivator and Rototillage treatments will produce any cumulative deterioration. To date, the wheat has been unaffected; the barley shows no consistent effects; but continuous shallow cultivation with implements other than the plough reduces the yield of mangolds.

Conclusions.

The extensive evidence summarized in this article casts strong doubts on the prevalent beliefs about cultivation. We can find no justification for operations beyond the minimum needed to get a seed-bed and to check weeds until the crop is well established. Work in excess of this minimum, far from increasing the crop, appreciably diminishes it. Our results do not stand

alone: they are supported by the recent work at Cambridge and by the conclusions from the large number of experiments made in other countries (particularly the United States), which conclusions we, in common with most British agriculturists, believed, at first, to be inapplicable to conditions in our country. We have been driven to revise our views.

It is probable that the current beliefs have arisen partly because of the often striking results of cultivations on the early stages of plant growth. Our own experiments have occasionally shown such effects, which, however, have disappeared by harvest time, so that the final criterion, the yield, has been unaffected.

The explanation of our results may possibly be that yields from land in good heart are not much affected by the degree of cultivation; if this be so, it becomes important to know whether yields from land in poor condition are appreciably improved by increased cultivation.

Both these points emphasize our challenge and reinforce our appeal for a repetition of the experiments on as many different soil types as possible.

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TWO CENTURIES OF CHESHIRE CHEESE FARMING.

Two types of perspective have to be borne in mind when the amateur turns historian. There is time perspective. Human progress can be traced backwards as a series of steps, but the length of the tread is incomparably longer at the bottom than at the top. Down to quite recent times the critical events of agricultural history are separated by great gaps of time in which each generation painfully relived the life of its fathers. New methods and movements came slowly and haltingly. To this day customs of byegone ages linger side by side with practices so new as to be still experimental. Of a great industry like farming it has never been possible to say " thus it was at a given date " ; it has always been " thus and thus—and thus."

Then there is probability perspective. We live to-day in a world of blaring publicity. Few tasks are more difficult than keeping things quiet. Events of all kinds are compassed about by a great cloud of witnesses, oral, written and pictorial. Even if all the witnesses do not agree, there is no lack of evidence about what we do and think. But two hundred years ago, few people could read ; fewer still could write ; what few did write wrote for the delectation of their moneyed patrons, and chose ink of a colour likely to please. As one passes beyond the day of printing, real evidence becomes scanty. Mostly the student must proceed by inference, finally by intelligent guessing.

The tale of Cheshire farming may be said to begin in those dim ages that the geologists call the Triassic, when the beds to be known later as Keuper marl were laid down. They were curious rocks ; a sort of calcareous clay. Elevated above sea level in the upheaval which ended the period they suffered the fierce elements of a primeval world for ages which stagger the imagination. Towards the end they lay for several millenia under great glaciers which scoured their valleys, ground off their hilltops and intermingled the detritus of native rock with other material from far afield. And as the ice retreated came primitive man, shiveringly, furtively, the hunter and the hunted. He came in waves, always from the South and East, and very little is known about him ; though traces of his crude hill-top fortifications still exist. He lived in an age of darkness.

There is a flicker of light about the beginning of the Christian era. It discovers Cheshire thinly populated by Celtic tribes, and the Romans are in possession—the XXth legion is at Chester. Their writers have given some description of the people, mainly by hearsay, and unfortunately not very accurate, but nevertheless illuminating. Cæsar himself wrote " The aborigines of the interior (of Britain) for the most part do not sow corn but live

on milk and flesh." But it was a false dawn. As the Romans leave, a semi-darkness falls, and for the next thousand years the turbulent history of the English peoples is fought out in the twilight.

Probably Cheshire escaped the worst of war's ravages. Attractive as its fertile soils may have been to the invader, Cheshire lay out on the Western fringe of the country, protected by great belts of Midland forest and marsh. At all events it seems to have remained throughout predominantly Celtic; the key to the history of its farming lies in Celtic tribal custom.

Over most of England arable land has always been held in high esteem, cultivation of corn the only worthy occupation of the farmer, dairying a women's affair. (One can sense scorn in Cæsar's reference to the northern tribes.) But the Celts were, and are, a pastoral people. Their villages were invariably small; their open arable fields were tilled by such insignificant numbers of families that the individual strips were often distinguished by name. Each village had but one arable field. It had not the permanence of the great Midland cornfields. The idea of reversion to grass after a few years of cultivation is common to all Celtic systems. It is an obvious device in good grass country. The system lent itself readily to consolidation and still more readily to enclosure of comparatively small holdings. It is, as a matter of fact, known that consolidation was going on in Cheshire in the twelfth century. Gray[1] concludes, from an examination of all the evidence he could assemble, that the county was mainly enclosed in the sixteenth century.

The first clear account of the area which has come down to us is the book published by Daniel King in 1656 under title "The Vale Royal of England." It is a compilation embracing two earlier "Brief Discourses partly Geographical and partly Historicall" by William Smith (about 1590) and William Webb respectively. It describes a pastoral countryside, not only settled, but evidently long settled. Cheshire had for long centuries been a

rights had been confirmed. Under such suzerainty every degree of nobility had flourished and multiplied till Cheshire became indeed a "seed-plot of gentilitie." In King's description the southern part of the county is so "garnished and adorned with the seats and habitations of Baronets, Knights and Gentlemen" as to leave on the modern reader the impression of standing room only. Most of the country estates were perforce small; many of them indeed less than 1,000 acres in area. Some townships are described as "well replenished with good farms," and Smith's

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[1] Gray. *English Field Systems.*

reference to the manner of life of the farmer is illuminating in its prevision of the inherent strength of self-contained holdings: "For this is to be understood that they lay out seldome any money for any provision, but have it of their own, as Beef, Mutton, Veal, Pork, Capons, Hens, Wild Fowl and Fish. They bake their own bread and brew their own drink. I know divers men which are but farmers that in their Housekeeping may compare with a Lord or Baron in some countrys beyond the seas. Yea although I named a higher degree I were able to justifie it." The whole book contains but two or three references to oxgangs of arable land. Plainly King's Cheshire is very much the Cheshire of to-day, save that the Henhull, Eardswick and Pool Halls of nobility are now the Hall farms of milk producers. A map of the Minshull area near Nantwich, dated 1702, now in the possession of Mr. Arthur Cookson, tells the same tale; it might be copied from the 6-inch ordnance of to-day. Wedge's report to the Board of Agriculture in 1794 estimates that, in a county of nearly three-quarters of a million acres, less than 1,000 were unenclosed.

Existing farm buildings are a history in themselves; at least a history of four or five centuries. They are collections of cow-sheds, grouped usually in $\sqcup$ or quadrangle form. The majority are of brick, built within the past 150 years; but many are half-timbered Jacobean and Tudor structures, while one at least, known to me, is wholly timber and preserves the ancient Saxon crutch.

Barnaby Googe, Camden and Webb all testify to the quality of Cheshire cheese; the two last mentioned, indeed, grow quite lyrical on the subject. Such a reputation could hardly have been recently acquired. It bespeaks an old established industry —how old, it is now impossible to say.

Local tradition traces cheesemaking practice back to Roman times, and certain writers of repute[1] state that cheese from this area was exported to feed the Continental legions. There seems no reason to doubt that the art has been generally practised since the remotest times; it would be a natural concomitant of pastoral life and cattle ownership; but it is difficult to imagine anything in the nature of a regular trade in the product before the fifteenth or sixteenth century. Most of the cheese, one would imagine, would be needed to feed the numerous landed gentry and their retinues.

The earliest cheese prices recorded are remarkably low. According to Thorold Rogers they stood at about ½*d*. per lb. or 5*s*. the long hundredweight throughout the fifteenth century, and though the figure must admittedly be read against the price-

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[1] See, for instance, Ingham: *Cheshire. Its Traditions and History.*

level background of the times, it is not suggestive of extensive commerce. A great trade with London and other large towns had, however, grown up by the beginning of the eighteenth century. Defoe, in 1725, says: "I am told from very good Authority the city of London only takes off (from this county) 14,000 Ton every Year; besides 8,000 Ton which they say goes every year down the Rivers Severn and Trent . . . so that the Quantity of Cheese made in this Country, must be prodigious great." Comment on the actual figures is almost superfluous. A mind which could conceive Robinson Crusoe was not likely to boggle at a few noughts. Sufficient that there was then a large trade; evidently a trade of long standing.

From the middle of the eighteenth century onwards there exist exact farming records. By chance and the goodwill of friends a number of these are in, or have recently passed through, my hands. They tell an illuminating tale.

MID-EIGHTEENTH CENTURY.

THOMAS FURBER.

Thomas Furber came of an old farming stock, closely associated with the Nantwich district of Cheshire. The family are believed to have held Austerson Hall, some four miles from the old market town, for over 200 years; and here Thomas was born early in the reign of George II. In 1767 he became tenant of a farm called College Fields, near Woore, on the estate of Sir John Chetwoode. This farm is on the edge of what is now considered the best cheesemaking area; it probably extended to about 100 acres. Towards the end of the century he moved to the family holding at Austerson. Throughout his farming life he kept, in small pocket-books, rough records of his main transactions. Not all of these have survived, but the earlier records bear every evidence of completeness and may with safety be accepted as a picture of his first years of tenancy.

His "account of all things I bought when I set up house, bought from May till Crismas 1767" covers several pages of his notebook and is perfect in its detail. Items of farm household and personal expenditure are listed indiscriminately—apparently in order of purchase—but may be classified as follows:—

	£	s.	d.	£	s.	d.
Farm Stock—						
20 cows	159	1	6			
1 bull	4	7	6			
6 two year olds	26	0	0			
4 yearlings	10	0	0			
2 horses	16	6	0			
15 sheep	4	4	0			
2 sween	3	10	0			
2 pigins	0	1	0			
				223	10	0

	£	s.	d.	£	s.	d.
Implements—						
Ironing harrows	1	1	0			
Suck mould	0	2	0¾			
Cart	6	0	0			
Tumbril	6	0	0			
2 backbands 10/6, 2 pares of chanes 14/9, belyband 10*d*., cart sadle 4/–, coler and housen 7/9, 2 bridles 7/6, 3 halters 4/–, cart whip 3/4	2	12	8			
Plow axx, axx, mattock rakes and small tools	2	7	6			
Cornhopper 1/6, 3 sween trufs 9/–, Grindstone and irons 6/6, 2 lathars 5/–, half misure 2/4, 30 lb. wt. 4/6, half hundard 8/9, peck 1/–, barrels 18/5, sundries 10/6, 2/7/11	5	15	5			
				23	18	7¾
Provender and Seed—						
Hay (at 1/3 per cwt.)	5	12	0			
Oats, beans, rye, pays, muncorn (meslin)	15	18	4			
3 mis. of rigres 6/–, 90 lb. clover seed 1/13/9	1	19	9			
				23	10	1
Dairy Appliances—						
Chees press scroos	0	18	0			
Boxes, cap, standards, plank	2	6	0			
Plank	0	15	0			
Cheestub	1	4	0			
2 barrels	1	5	0			
Cans, pale, haresives, chees bords, chourn, 3 chespets, etc.	3	4	8			
Furnis, 70 gal. at 8*d*. per gal.	2	6	8			
2 doors 4/4, hanging do. 5/–, bars 14/10	1	4	2			
				13	3	6
				£284	2	

	£	s.	d.
Household Goods—			
6 cheres, a childs chear and 2 armes chear	0	15	0
2 oval tables	1	2	6
Warming pan	0	10	6
44 lb. wool	1	2	0
Weaving 10 blankets	0	10	0
Bed at 7*d*. per lb.	2	1	5
2 mats and bed cords	0	4	4
Spining Wheel	0	6	6
Long spining wheel	0	7	6
A fruit dish, a ciming dish and butterprint at 11*d*., 6 transhars 1/3, 2 boules 1/6, 2 basins 7/–, flech fork and ladle 2/–, Iron pot 2/–, Fring pan 3/6, four tin canes and a saspan 4/2, bread dish 1/–	1	3	4
Fireshovel 3/4, pare of tongues 1/9	0	5	1
Parler grate 9/6, great 71½ lb. at 4*d*. 1/3/10	1	13	4
2 chests 1/2/0, coffer 4/–, sault soffer 7/–, saulting turnel 1/8/0, tub 5/–, kneading turnel 9/–, stand 9/–, cloas basket 2/4.	4	6	4
Boiler 16 gals. at 8d. 10/8, pot 8 gals. 6/–	0	16	8
10 locks 10/6, 2 cubard doors 5/6, 5 flaskits 1/9/0, pare of bolies 2/–, block 4/16/6, pare of mittens 3/–, stand 9/–	7	15	6
	£23	0	0

This first-hand record is so similar to the estimate drawn up by Arthur Young in his famous essay on the relative merits of grass and arable farming that it is worth setting the two summaries side by side :—

	Furber (actual) £	*s.*	*d.*	Young (estimate) £	*s.*	*d.*
Rent	100	0	0	87	10	0
Furniture . . .	23	0	0	30	0	0
Stock. . . .	223	0	0	112	0	0
Implements . .	24	0	0	19	0	0
Dairy furniture . .	13	0	0	12	0	0

Young, it may be recalled, was a great believer in grass on good land ; in the essay referred to he was concerned to show that a stock farm did not require any more capital than an arable, and to this end he reckoned cows at £4 per head. This seems a little strange since in his Northern tour he valued them at £7. Comparisons of cow prices are, of course, always difficult by reason of the great variation according to the stage of lactation. Nevertheless, one is forced to conclude that in this case Young adjusted his figures a little to fit his argument. Furber paid £4 10*s.* apiece for his two year olds. His cows—doubtless new calved—cost almost exactly £8 per head. They do not seem to have been in any sense a choice herd. They are described by colour or name, and suggest, in fact, rather a mixed lot :— "Broadhead a red cow, Butey a red finch, Blackwall a black, Whiteface a pide, Whiteflank a black pide, Pratty a brinded cow" ; and so on. Young himself, touring the county five years later, speaks of the cattle rather disrespectfully : "Their breed of horned cattle is a mongrel between the long and short," and again, "their cows are of an ordinary breed, loose boned."

Relative to other things, cows were undoubtedly dear at this period. Taking the prices recorded in Furber's books for 1767–69 and accepting Curtler's summary of Thorold Rogers' prices for the earlier periods, comparative figures were :—

	1259–1400 *s.*	*d.*	1580–1700 *s.*	*d.*	1767–69 *s.*	*d.*
Wheat per qr. . .	5	11	39	0	42	0
Cheese, per lb. .	0	0½	0	3½	0	3½
Cows . . .	9	6	60	0	160	0

While, therefore, corn and cheese stood at about seven times the prices of the fifteenth century, cows were more than sixteen times the price. In 1770 a new-calved cow was worth rather more than the annual value of her milk.

It is plain from the capital outlay that College Fields was not a purely grass farm. Furber grew some wheat and oats ; and, in his early years at least, kept account of the sales. They appear to have averaged 38 "misures"[1] of wheat (at 6*s.* 6*d.*)

[1] Clearly a Cheshire measure or bushel of 75 lb.

and 160 "misures" of oats (at 2*s*.)—the produce of some eight or ten acres of land. There is no evidence of potato or root cultivation.

Labour.—Furber's labour records were kept in great detail. When he started farming he employed one man and three women (or two men and two women) regularly, and a little occasional labour; contracts were made yearly, generally in January, for 50 or 51 weeks' service, board being provided in all cases. Throughout the year, advances in cash or kind were made periodically, the account being finally settled at Christmas. The following typical case may be cited :—

	£	*s.*	*d.*
1768. Hired Martha W— for £2 7*s*. 6*d*. wages.			
Paid her torts her wages	0	1	0
Paid her torts her wages	0	13	0
Paid her more June 14	0	0	6
Paid her more . .	0	1	0
To 2 yd. of cloth for a shift	0	3	0
Paid for a stript cotton	0	1	3
Paid her more . .	0	0	6
To a pare of shoes .	0	3	0
Paid her more . .	0	0	6
To a bottle of tinear of mor.	0	0	6
Paid her more Sep. 11 .	0	3	0
Oct. 23 paid her to her wages	0	10	6
Nov. 16 paid for a hankshaf	0	2	4
Nov. 23 paid for a gretecoat	0	9	0
To a pare of Stockins .	0	2	0
	£2	9	7

Paid her all her wages for the year 1768 and paid her above her wages 2*s*. 1*d*. by me.[1]

THOMAS FURBER.

Women's wages at this time were generally £1 15*s*. to £2 10*s*. per year, while the wages for males ran from £2 10*s*. for a youth up to £5 5*s*. for a man. Many pages of the books are occupied by accounts such as that quoted above. They make dismal reading. The literature of the period is, of course, full of denunciations of the thriftless poor (Arthur Young is particularly severe on them). They had indeed their merry makings. Dolly D— drew 7*s*. in 1781 at "Nantwich Rases" and in the same year 4*s*. at Whitchurch wakes; Solomon S— was allowed a "sub" on "Guttes tuesday," and so on. These, however, are small items to set against a year's labour for £2 10*s*. To modern eyes it does not seem strange that discontent manifested itself. One of Furber's pages reads :—

[1] Actually, Martha seems to have drawn 3/7 too much. Furber's accounts were occasionally undercast.

1775 Hired Solomon S— for £2 10s. wages.
Paid him his quarters wages till Lady Day, 12/6. On the 27th day of March he over run me and he went away on the 29th he come againe but not hired, on the 3rd April hired him by the weaks at 1/- per week till Mikelmas and 10*d.* per weak till Crismas.

This particular gentleman seems to have given trouble later on, for some years later there is another series of entries :—

At Mikelmas 1787 Jane and Solomon S— went away and was Dr. to me for rent one pound nine shillings.

	s.	*d.*
Oct. 30 received torts rent	2	0
Nov. 3 „ „ „	1	0

And here the record ends—somewhat disastrously for his master it would seem. .

Later on, when wages had risen a little, one may read :

Hired John E— for £7 wages and carrge. of a load of coals.

March 23 paid John E— a quarters wages and gave			
him 5s. for to go	£1	15	0
	£0	5	0

Meat.—On a farm such as this it is no surprise to find that cattle were slaughtered for use at home. Three of the original stock of cows are recorded as "killed self"—presumably for salting down. Unfortunately, the records on this score grow scantier as the years go by; there is therefore considerable doubt as to the extent to which the farm stocked the larder. From the very outset, however, some meat was purchased, and it is noteworthy that the size of the joints increases steadily throughout the year. In the spring and early summer the purchases are chiefly veal, with an occasional leg of mutton and small joints of beef. Later on the beef joints are larger, and towards Christmas there is a purchase of a quarter or a side. Beef and pork were both bought at 3d. per lb. in the early years.

Cheese.—Cheese, the main product of the farm, was usually sold to factors in big lots, during the autumn or winter, and delivered to Frodsham, Chester or "Whillock" (the canal at Wheelock did a considerable carrying trade) payment being made at a later date—sometimes by instalments.

In some years however, delivery was not made until the cheeses were nearly twelve months old. A signed note in the book reads :—

Jan. 21, 1769. Bot. Thos. Furber cheese at 34 deliver to port. R. Capper.

May 11, 1769. Then weighed Mr. Thos. Furber's cheese. 166 cheeses. 50 hund. and ¼. R. Capper.

Stock.—After the original stocking no records of cattle bought appear in the books, though at least seven of the original cows were sold during the first two years. No doubt the herd was substantially maintained by home breeding: calves—presumably the males only—were sold at birth at approximately 10*s.* each.

Finance.—Owing to the somewhat irregular way in which the original records have been made, it is impossible to draw up accurate statements of income and expenditure; but after careful analysis of the books I am confident that the following summary presents a substantially true statement of the average outgoings and income in the three years 1767–69 :—

Expenditure.	£	*Receipts.*	£
Wages	11	Wheat and oats	28
Meat	8	Pigs	10
Malt	5	Sheep	—
Rent	100	Calves	7
Tithe, poor lay, etc.	6	Cheese	80
Pigs	2		
	£132		£125

Admittedly the income does not quite balance the expenditure. So far as it goes the account confirms Arthur Young's view that cheesemaking at this period was not a very remunerative business. "It is extremely mysterious," says he, "but I cannot possibly discover wherein lies the profit of these dairies."

It is of course necessary to remember that the three years in question were the first years of Furber's tenancy. His cows were all newly purchased. As might be expected their yields were poor. His "make" represents but 2½ cwt. per cow, worth £4; whereas Young states repeatedly that the produce of a cow was worth £5 to £6. None the less, the gross income of the farm is little more than sufficient to meet the rent. At 34*s.* per cwt., not enough cheese is produced to meet the landlord's account. This comparison (cheese *v.* rent) is worth bearing in mind for future reference.

THE NAPOLEONIC WAR PERIOD.

Furber's farming life covered the period of the Napoleonic wars, but his surviving records are rather scrappy throughout the last three decades of the eighteenth century—probably some of his books have been lost. A sidelight on the state of local farming during the last years of the century may be obtained from the neighbouring county of Staffordshire, where William Tompson was tenant of the Forge Farm, Abbots Bromley, a holding of 168 acres.

William Tompson.

William Tompson was born in 1737, the second son of a substantial farmer and "iron master." At the early age of 17 he commenced to keep farming records, and from 1766 until his death in 1815 he probably recorded every financial transaction of his farming life. Nearly all of his books have been preserved. The record of his farming really forms a history quite separate from the present, for the whole tale of Staffordshire farming derives from the three-field Midland system; Abbots Bromley is a typical "open field" village; and Tompson was, from youth to old age, an arable farmer. But for some years he was a cheese-maker also.

The Forge Farm was rented in 1790 at £120 per annum. It is all heavy clay-marl, low lying and poorly drained—Tompson spent a good deal on guttering and "soughing." During the first ten years of his tenancy there was no farmhouse, but when this was built, dairy work commenced. He had earlier found it advisable to seed down certain difficult fields, and at this time the farm comprised 110 acres of arable and 58 acres of grass.

The dairy herd consisted of 10 or 12 cows and heifers, with two or three "twinters," all bulled for spring calving.

The stock was maintained chiefly by home breeding, but occasionally calves were bought at about £1 each. Hirons (blackquarter) was a common source of loss and rowelling was practised to some extent.

Presumably some of the oats and beans grown on the farm were fed in winter. The only feeding stuff mentioned in the books is bran, small lots of which were bought from time to time at 1*s*. per strike.

Yields of cheese may be calculated with a fair degree of accuracy from the records of sales. They averaged almost exactly 2½ cwt.—just short of £5 worth—per cow.

On a farm still largely arable, the total expenditure on labour naturally ran much higher than on a cheesemaking family farm; and the following summary of Tompson's average income and expenditure during the five years 1790–94 is worth quoting if only by reason of the contrast it affords with the accounts of strictly dairy holdings:—

Expenditure and Receipts.

	£		£
Wages	90	Wheat	122
Rent	120	Oats and barley	83
Rates, etc.	33	Cheese	68
Stock	34	Stock	92
Sundries	52	Sundries	22
	£329		£387
Balance	58		

The accounts show a steady and consistent profit, amounting to about £60 per annum, or about four times a day-labourer's wage, plus living costs of the household. Prices were, of course, on the rise—wheat sold at 7*s*. 6*d*. per bushel, nearly 1*s*. advance on the price ruling 20 years previously. Labour as yet had advanced but slightly. Rent formed but one-third of the total outgoings, and was easily met out of wheat sales. How far cheese contributed towards the profits one can but guess. At a modest estimate it was yielding at least £1 per acre of ground occupied by the stock. It sold at 41*s*. per cwt. instead of the 34*s*. common in 1767. It was destined to rise to 56*s*. per cwt. shortly—Tompson records prices of 49*s*., 50*s*., 45*s*. and 56*s*. in the closing years of the century; and though it never soared to the relative heights of wheat in 1801, it reached 81*s*. per cwt. in that year, and for the next 70 years it rarely fell to 60*s*.

An excellent account of Cheshire farming in this period is given by Holland in his survey for the Board of Agriculture (1805). "In few parts of kingdom," says he, "is the average rent of land higher than in Cheshire." This he attributes in part to the proximity of the county to the large markets in Manchester and Liverpool and in part to the high prices of cheese and butter.

After much enquiry Holland accepted and reprinted Wedge's original description of the cattle, viz.: "There is no species of cattle peculiar to this county—the long horned Lancashire, the Yorkshire shorthorned, the Derbyshire, the Shropshire, the Staffordshire, the Welsh, Irish, Scotch and the new Leicestershire have at different times been introduced and the present stock is a mixture of all these breeds." A very detailed account of the method of cheesemaking is given. As to the profits of farming, Holland confesses himself beaten :—

> "It cannot reasonably be expected that the farmer who rents his land should consent to have a statement of his profits brought forward in a way which would naturally attract the attention of his landlord. In general, as cheese is the principal object on the greater number of Cheshire farms, all farming expenses are to be set in opposition to the profits arising from this article of produce."

He concludes, however, that "the greater number of dairy farmers must make 15 per cent. on their capital."

There can be no harm, 130 years afterwards, in looking into the books of the period to see how farmers were faring. Thomas Furber's records throw some light on the question. He is getting an old man now and is not very regular in his book-keeping, but by piecing together records from various years, a fairly reliable average for a decade may be obtained. He is at Austerson Hall, Nantwich, now—a heavy farm of about 200 acres; we shall have to guess his rent, for it is nowhere stated. If the

guess is correct, his average expenditure and receipts for 1801–10 are as follows :—

Expenditure.	£	*Receipts.*	£
Wages	18	Wheat and oats .	82
Meat	20	Pigs	22
Malt	28	Sheep	9
Rent	200	Calves	15
Tithes, poor lay, etc. .	29	Cheese	256
Pigs	1		
	£296		£384

Much more exact information comes from the books of Ralph Basford.

RALPH BASFORD.

Ralph Basford farmed in the neighbourhood of Crewe for some 20 years at the beginning of the nineteenth century. He had inherited from his father an account book, which the latter had used at intervals from 1789 onwards for memoranda of small retail sales. Ralph, however, used it as a day-book, with great regularity.

Basford was a constable, a churchwarden, and a trustee under one or two wills of relatives or neighbours, so naturally used his book for records of expenses in these offices. One may learn from these pages the amounts spent in issuing bread and vagrant warrants, attending meetings, various "jurneys" to Nantwich and elsewhere, and in "taking J.B.—for stealing boards and attendance on him"; how much the bellringers had to be paid for "ringing good news" in 1813; and the fact that new churchwardens had to pay at a visitation :—

> 1816. Spent at the visitation 3/–, the old wardings go free from shot and the new churchwardens pay.

In his early married life Basford appears to have done most of the family shopping, items such as "shugger" and soap, "curans," tea (5*s.* and 7*s.* per lb.) appear at frequent intervals. Charges for "churching my wife and child crisened (1*s.* 6*d.*)," for "innoculating the children," for "beryin" one of his sons, for their school fees (mainly covered by counter charges for ploughing the schoolmaster's land) occur from time to time.

But income-tax returns were beyond him. Each year a payment of 2*s.* 6*d.* for filling in these papers appears among the expenses.

Furniture appears frequently in the early years; and in 1816 he founded a library with volumes which bear eloquent testimony to the serious purposiveness of life in that day, viz. :—

> *Family Herbal*, 27 vols. at 6d.
> *Reflections for every day in the year on the works of God*, 25 vols. at 6d.
> *Human nature, in fourfold state*, 15 vols. at 6d.

It goes almost without saying that the book contains recipes for treatment of sick animals, and two at least are worth reprinting in this fastidious age :—

> *For a cow that is a suter.*[1] Take a quart of dwarf box chopt small, a quart of Lant, an ounce of bould almeneck, one pipe hedful of Cut tobacko. Give it all together could.

> *For a horse that as got the bellyake.* Take two handful of hendung bouil it in a quart of ale. Give it altogether worm.

The varied nature of the entries, and the somewhat erratic manner in which consecutive pages have been used, make it a little difficult to piece together the tale, but fortunately there are few undated records, and such clear evidence of regular use that the book may safely be accepted as an accurate history of his farming transactions.

"I came to Weston November 4th, 1799. The first cheese made March 31st, 1800" is, for instance, definite enough. This entry relates to his first farm, Stowford.

1799–1804. *Stowford Farm.*—Stowford Farm, Weston, Crewe, which he entered as a newly married man—probably as successor to his father—was on John Crewe's estate.

A list of the various fields and their acreages, preserved on the inside of the cover of the book, makes it clear that more than half the land (67 acres to be accurate) lay "within the compas of the park" ; 53 acres of land out of the park—11 fields in all—seems to have been in somewhat scattered parcels. Of interest among the field names are Day heys and two Coppey fields within the park, two Bousey pastures, Cockwalks and "7 demath."

An outline of the farming operations, with dates on which sowing and harvesting commenced and so forth, is recorded in each year.

As the acreages under each crop are in some cases stated as well as those of the fields, it is presumable that where fields only are named they were devoted wholly to the crop ascribed to them. One can therefore calculate the acreages under each crop with some degree of accuracy. Basford appears to have grown, on an average, 15–20 acres of wheat, 20–25 acres of oats or barley and 15–20 acres of hay each year ; presumably there were 10–15 acres of fallow, while 35 or 40 acres were grazed. There is no mention of root crops on this farm, barring small areas of "tatoys" or "tatous." It is not possible to estimate the yields of corn, since a herd of 20 cows was kept and pigs were fed.

The farm was rented at £110 2*s*. 6*d*., or £1 per acre, the tenant covenating to deliver a cheese and do two days' team work

[1] An animal with persistent diarrhœa.

annually for his landlord. Tithe, dues, land tax, poor levies and constable's mise[1] amounted to a further £36 annually.

1804—1818. *Church Farm, Barthomley.*—In August, 1804, Basford took over the tenancy of Church Farm, Barthomley, paying the outgoing tenant £48 19*s*. for his share of the wheat growing on the farm. There is no record of its area, but judging by the rent (£210) and the land tax, it is fairly safe to conclude that it was in the neighbourhood of 210 acres. Practically the whole of this farm was ploughable, and nearly every field, except certain meadows, was in fact ploughed during the next fifteen years. A certain amount of turnips were grown; the herd was increased to about 25 cows; growing corn was occasionally bought from other people, and from 1812 Basford had a horse-threshing machine, with which he threshed for other farmers at 6*d*. per bushel for wheat and 3*d*. per bushel for oats; but the farm was obviously managed on the same lines as Stowford, and for all practical purposes the records of the two holdings may be treated together.

Labour.—Stowford farm was worked with a permanent staff of two women, two youths, and a man, all living in, the wages of the women being £2 to £4 10*s*., that of the youths £2 to £5 5*s*., while the man received £10 10*s*. or £11 10*s*. In addition, however, one or two men were employed, partially on day work and partially on piece work, throughout the greater part of the year, so that the total labour bill amounted to about £40 per annum.[2]

"Diching and paling" (8½*d*. per rood), "diching and tining hedges" (8*d*. per rood), appear frequently in winter piece work payments; occasionally, it is noted that the hedger allowed a few shillings for the right to use the brash.

Implements were made at home and marling was practised regularly, and entries such as "paid for ale fetchd to the pit 7*s*. 6*d*." suggests that, at the close of the season (in August) the labourers got some recompense additional to their 1*s*. 2*d*. a day. Among minor expenses in 1809 occurs an entry: "Paid Chubbey for cetching rots (rats) at 4*d*. apiece, 19 rots 6*s*. 4*d*."

Church Farm naturally required more labour than Stowford. Here the annual expenditure amounted to £20 or £25 on boarded labour, and a further £50 or thereabouts on day and piece work. The fact that the total fell by £30 in 1816 may probably be explained by the entry of his children into the farm staff. A

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[1] Originally a levy payable to each Earl of Chester on his accession, the term was later applied to any fixed charge on a township. In Basford's book the usual entry is "Constables 8 mise 8/10."

[2] Allowance should, of course, be made for their keep. If half the cost of meat, coal and groceries is charged to labour, the total is raised to about £50 per annum.

gradual increase in rates of pay during the period may be noted.

There is again a pathetic ring about many of the records :—

1816. Hired Ann P—— for £5 5*s*. She left May 30th. Paid her £2 3*s*. She left to go to her settlement to ly in.
July 11th. Hired her for the year out for £2 6*s*.
Hired Mary M—— for 1816, for £6 6*s*.
She left with child March 10th, paid her £1 4*s*.
Hired Mary N—— or old big Molley, for 1816, from March 16th for £4 10*s*. She run away with child in beginning of May. Paid her nothing.
Hired Jane G—— for 1816 from May 26th.
She left September 4th. Paid her £2 5*s*. 7½*d*.

Barthomley was too far removed from the Potteries, whose industries were then rising to fame, or from any other developing commercial centre, to allow of women finding industrial employment. For a select few there was, of course, domestic service with the gentry. What this involved may be gathered from the following letter, a copy of which Mr. A. Lloyd, head master of Sound School, Nantwich, has kindly given me :—

—— Hall,
Nov. 16th, 1829.

Mrs. ——

I am obliged to you for your information respecting the young woman you think will suit me as a dairymaid and as I have not yet engaged one I will trouble you to make further enquiries about the Person you recommend. I want a very clean, active, stirring woman—one who is not afraid of work. She must perfectly understand the management of milk and butter and the feeding of pigs, but as we never milk more than four cows she will have time to assist the kitchenmaid to wash up after dinner—she will also have to clean the Servants' Hall, Butler's Pantry and the Cellars, and to make herself useful in anything she may be wanted for. Of course, she must assist in washing and ironing and I shall require her to be very steady in her conduct and to go regularly to church. My wages to a Dairymaid is £8 11*s*. 6*d*. a year, and they find their own Tea and Sugar. I must observe that I don't like my servants to be finely dressed and that I do not allow any of them (except my own maid) to wear white gowns or flounces. If the young woman you recommend has no objection to serve me on the above terms I will thank you to engage her for me and as she is out of place perhaps she can come to me in about a fortnight when my present dairymaid is to leave. Be kind enough to let me hear from you as soon as possible and send me the young woman's name.

(Signed) Anne ——

It may be supposed that comparatively few country women could reach the required standard of excellence. For the great bulk the choice lay between farmhouse service and the poor law ; and if one may trust that acute but pungent critic Arthur Young, the majority chose the latter.

The Dairy Herd.—The dairy herd consisted of 20 cows on the first farm and about 25 on the larger holding ; evidently a fair proportion of the recruits were purchased, prices of £17 17*s*. and £18 18*s*. for individual animals being recorded.

Four or five cows were sold off fat, annually, prices ranging from an insignificant figure up to £18. Occasionally dead weights of cows sold are recorded. Two, for instance, sold in 1801, weighed 29 sc. 12 lb. and 32 sc. 3 lb. respectively—dead weights corresponding with 1,000 lb. live weight. The price of these carcases was 7*d*. per lb.

The bull calves were sold at or soon after birth to a local butcher at prices ranging from 7*s*. or 8*s*. to 25*s*. A few were fed for veal to 100 or 120 lb. dead weight, and sold at 6½d. per lb. A somewhat ominous note attaches to one entry: "Sold one calf *for rearing* 4*s*."

Corn.—On Stowford farm oats was the chief corn crop, sales amounting annually to 270 measures, while wheat sales totalled only one-third of that figure. Church Farm was evidently better wheat land, for here Basford sold over 250 measures of wheat annually, while oats were but 200 measures. A few oats were sold as oatmeal at £4 4*s*. per load. Small quantities of muncorn (mixed wheat and rye) were also grown.

Pigs.—Like Thos. Furber, Basford had few dealings in pigs. In his first three years at Stowford, for instance, he had but two sows, and only 11 animals were bought. Evidently he was in the habit of speying his gilts—there are several references to "cut sows." Pigs of 16 to 20 score were sold at 6*d*.–7*d*. per lb. in the early part of the century, and 4*d*. per lb. in 1816.

Sheep.—Sheep also played an insignificant part in farm economy. At Stowford only 21 were sold in three years, while at Barthomley there were sometimes no sales for two or three years on end. The most striking feature about the few transactions recorded are the relative prices of lamb and mutton. Lambs of 34 lb. sold during the summer made but 6*d*. and 7*d*. per lb., while sheep of 67 and 73 lb. made the same price per lb. A few sheep were slaughtered at home.

Foodstuffs and Manures.—With the exception of one lot of "akorns" (1*s*. per measure) there is no record of purchased foods, the nearest approach being charges for grinding oats; and the only manure used, apart from dung and marl, was lime, small quantities of which were drawn from Astbury, near Congleton. Usually this was bought by the measure (7*d*.), occasionally, however, by weight, 13*s*. 6*d*. per ton being the price in one case.

Finance.—The records are kept in such great detail that accurate summaries of expenditure and receipts for most years can be prepared. Calculation of profits presents difficulties owing in part to possible differences in carry-over of corn in stack, and in part to the fact that the year's make of cheese was sometimes not sold out until the following spring. It has been necessary in preparing the following table to reckon amongst the receipts for 1802 the proceeds of a sale actually effected in the

early part of 1803. With that exception, however, the following statements are extracted direct from the day book :—

Expenditure.

	Stowford Farm Average 1800–02 £	Church Farm Average 1814–16 £
Rent	110	210
Rates	36	91
Cattle	16	55
Sheep	10	2
Pigs	18	2
Implements	2	2
Salt	3	6
Food	8	5
Lime	5	5
Seeds	5	9
Beer	5	12
Labour	42	72
Sundries	1	3
½ Coal	2	2
½ Groceries	2	—
½ Meat	5	—
Wheat	—	17
	270	493
Balance	145	50

Receipts.

	Stowford Farm Average 1800–02 £	Church Farm Average 1814–16 £
Wheat	60	157
Oats	74	50
Other produce	9	21
Cows	51	45
Calves	18	21
Sheep	8	3
Pigs	29	22
Horses	5	3
Sundries	8	13
Cheese	153	208
	415	543

The difference in the surpluses on the two farms seems highly significant, especially in view of the fact that, on the latter, Basford probably had much more help from his family than on the former.

Prices of corn were certainly rather lower in the later years, but cheese prices, on the other hand, were higher. Labour rates were but a trifle higher. The main reason for the lower returns on Church Farm was the higher charges for rent and rates. In the aggregate these were twice as high on the larger farm, though its productivity, measured in terms of corn and cheese sales, was only about one-third greater than that of Stowford. Either Stowford was a very cheap farm or Church Farm was a dear one. On the whole, the former is the more probable. Both farms, however, were profitable ventures. On Stowford the profits were 30 per cent. on turnover. Even on Church Farm they were 10 per cent.

William Williams.

For the next decade evidence comes from the account books of William Williams, a cheese factor and farmer, who tenanted a holding on the Cheshire-Staffordshire border for 18 years (1812–29). His accounts are set out much more formally than Basford's. They are, in fact, statements of account, rather

than day-book records. Each year's records commence on a fresh page; expenditure and receipts are listed separately and in most cases are totalled and a balance is struck. Frequently, a note on the nature of the preceding season is added—as thus :—

> The year 1821 was a very bad Harvest, one fourth of the corn rotted in the Field. I had more than one Hundred measures of Wheat Ground for the Pigs.
>
> The year 1826 was a very Dry Year and every Crop fail'd. Wheat was the best, no Turnips, no Clovers, no Barley no Oates no Hay. Cows very little but water to subsist on.

These notes, be it said, are all in the best tradition of British farming; that is to say, they are invariably of a lugubrious character.

Though neither the name nor the acreage of the farm is given in the book, it is clear that it was a holding of 200 acres or thereabouts, with 60 or 80 acres of arable land and carrying a herd of 35 to 40 milking cattle. Probably the tenant himself did not engage in farm work to the same extent as some of those others whose records have been examined in this article, but his system of farming was essentially similar to that of Basford and Furber. Apart from rent, tithes and poor lays, labour was his chief item of expense. He had two or three youths and a similar number of women living in, their wages totalling £25–£30 per annum. A further £30 per annum was spent on day work and piece work—the latter mainly for harvesting and threshing. The rates for such work fell slightly during the second decade of the century. In 1820 he was paying 1*s*. 2*d*. a day, while in 1824 the rate was 1*s*. only; similarly, threshing rates fell from 7*d*. or 8*d*. a measure to 5*d*. in the same period. Salt was quite a considerable item of expense. The price was fairly stable at about 16*s*. 6*d*. a bushel, until 1823 when it fell suddenly to 6*s*.[1] Down to 1826 there are no records of foodstuffs bought. In that year, however, he bought, along with a consignment of grain from Liverpool, three bags of India meal at 2*s*. 2*d*. a bag.

Cheese, of which he produced about 90 cwt. annually, was not always disposed of in large consignments at a flat rate; in one season prices of 56*s*., 66*s*., 57*s*., and 78*s*. per cwt. are recorded for different lots.

Williams' stock appears to have been maintained entirely by home breeding; in ten years the only cattle bought are two or three bulls and three calving heifers. About 20 calves, doubtless the bulls, were sold annually, and six to eight cows were drafted out. From his small flock of sheep about ten lambs or hoggs were sold off annually, while pigs yielded an annual income of £20.

[1] Owing to the removal of the salt tax.

Finance.—Williams' accounts for the years 1820–23 have been averaged and are set forth below. Household expenses, wherever recognizable, have been excluded. It seems probable that some £20 for servants' wages has been accidentally omitted from the original record in the year 1821–22, but as it is impossible to be sure on this point, the total has been left as shown in the book.

Expenditure.	£	*Receipts*	£
Rent	356	Calves	22
Rates, etc.	60	Cows	31
Cattle	3	Sheep	12
Seeds	8	Pigs	20
Salt	12	Wheat	134
Lime	—	Beer	7
Malt	7	Oats	4
Labour (farm)	66	Potatoes	3
„ (artisan)	23	Cheese	370
Sundry	3	Sundry	1
	£538		£604
Balance	£66		

Trade in Cheshire Cheese.—As Williams was a cheese factor as well as a farmer, a few words may appropriately be introduced here on the trade in Cheshire cheese. Cheese was formerly a much more important item in the dietary of the English people than it is now. In the early part of the eighteenth century "barley bread with milk and cheese was the general food of the poor" and the cheese mongers of London were a powerful community, owning a whole fleet of ships for the transport of cheese from Chester and Liverpool.

The cheese was bought in the first place by factors, as witness the records of Furber's books for 1767. This entry suggests an annual sale by the farmer of the whole of his season's make. A little later, however, Basford's book shows a clear distinction between "the make" and the "lattermake," while later books, to be referred to presently, distinguish three distinct types—"boosey cheese," made while the cattle were still housed in the spring, "the make," and the "lattermake," the first selling, as a rule, at a much lower price than the make, and the lattermake commonly commanding an intermediate price. Thos. Leech, for instance, sold in 1834 as follows :—

Boosey	48/– per cwt.
Make	69/– „ „
Lattermake	52/– „ „

A notebook kept by William Williams shows a remarkable range in prices paid to different farmers in the same season. In 1831, for instance, bargains at 47*s*., 53*s*., 63*s*., 68*s*., and 78*s*. respectively are recorded.

The factor was primarily a grader and doubtless derived a large part of his income from his skill in judging cheese—and men. He often advanced money on cheese in stock. The following records are typical :—

> 1830. July 13th. Lent Mr. G. E—— of Bridgmere, Twenty pounds on the Chs. now in his house which he promises to deliver to my order allowing me two shillings (per cwt.) commission for selling and all reasonable expenses with lawful interest for same.
>
> 1830. Aug. Bt. Mr. A——'s Cheese at 48/– and 20/– over if can afford.
>
> 1830. Oct. 25th. Bt. Mr. J——'s cheese of Shavington at 56/– and 3 months discount, returned 20/– over to the Dairymaid.
>
> 1831. March Bt. Mr. B——'s cheese at 75/– if too dear to have a handsome return.

The factor had, of course, his difficulties to contend with :—

> 1820. May 31st. Sold Mr. M——'s cheese at 40/– per cwt. it being very much dammaged in the vessel it was shipd in so that it was obliged to be tied round with tar ropes and cloths to keep it from being lost in the streets. the monger Mr. S—— offered £5 to be of the bargain.
>
> 1834. July 7th. Sold per F—— of M——. Greater Rogues was never in the cheese trade. I hope nobody belonging to me will have anything to do with them.

Towards the middle of the century a distinct tendency to sale by farmers in smaller lots is noticeable—often to two or three different factors in the same season. The cheese is sold rather younger, too. From then on there is a gradual shortening of the period of farm storage, until to-day most is sold when but a few weeks old.

Early Victorian Period.

The early part of Victoria's reign is generally regarded as a period of progress in English agriculture. It certainly was in Cheshire, as Paley's essay[1] of 1854 testifies. Landlords everywhere were encouraging drainage by providing pipes; bones were being used in quantities which to modern eyes seem prodigious; local stock was being improved by the introduction of Shorthorns from Yorkshire—indeed a "Cheshire Shorthorn" was gradually emerging, thanks to the services of dealers, the rise of local cattle fairs, and the foundation of agricultural societies. Farm buildings were being enlarged and dairies improved (despite the survival of regulations which allowed a dairy but one window duty free); curd breakers and lever presses for the cheese were coming into use.

Green crops were steadily growing in favour, especially in the north of the county, where the lighter land and adjoining markets were giving rise to the arable-and-milk farming characteristic of to-day. On the heavy lands of South Cheshire, where cheesemaking remained the universal practice, arable land still

[1] *R.A.S.E. Journal*, 1854.

formed about a fourth of many farms—agreements frequently limited the plough to that fraction—and few roots were grown. Most of the plough-land carried two or three straw crops, and was then seeded down with ryegrass and clover for at least eight or ten years. The record books of Thos. Leech illustrate the rising standards of farming in the period.

THOMAS LEECH.

This tenant held Brine Pits Farm, Nantwich, from 1828 to 1854. It was a heavy, wet farm of about 200 acres, rented at £270 per annum. His books indicate that 30-40 acres were kept under the plough, and a small herd of sows was maintained. He had 26 to 30 cows, and cheese constituted his main source of income. Unfortunately, his labour records are lost. But his income for the first few years can be calculated pretty closely, and his annual statement of accounts for the first few years must have read something like this :—

Expenditure.	£	*Income.*	£
Rent . . .	270	Cheese, 87½ cwt. .	282
Labour, Cattle, Corn, etc. . .	70–100	Wheat, 150 measures	70
		Pigs 10 (sows, stores and fat) . . .	18
		Cows, 6	39
		Calves, 16 . .	12
		Horses and ponies, 2	36
		Sheep, 1 . . .	1
	£340–370		£458

From the very outset his rent book shows him to have been engaged in pipe draining. Much larger allowances presently appear for bones. The precise arrangements between tenant and landlord are not quite clear; nor is it clear how much of this popular fertilizer was applied: but, at all events, in 1833-34 there are deductions amounting to £100 in respect of bones applied by the tenant; in 1835-36 a further allowance of £132 15*s*., while in 1839-40 no less than £200 was deducted from a total rent of £270 in recognition of the application of bones by the tenant. The earlier allowances seem to have been in the nature of gifts to the new tenant; but on the 1839-40 dose, interest at 4 per cent. was charged for one year, and in 1841 the rent was raised to £286 per annum. Bones were obtainable at this time at 90*s*. per ton. The total quantity applied between 1833 and 1839 must, therefore, have amounted to at least 100 tons. Evidently this did not satisfy Leech, however, for in 1844, and again in 1845, he obtained allowances of 10 per cent. in respect of bones applied. He was determined to make the farm carry more stock. Whether or not he was successful we may judge from the record of his cheese sales.

This record is almost complete for the whole period of his tenancy, and may conveniently be summarized as follows :—

	Average annual yield in cwt.	Value. £
1829–33	88½	291
1834–38	120[1]	421
1839–43	126[2]	459
1844–48	130[3]	427
1849–51	133[4]	432

[1] Based on four years. No record of weight in 1835.
[2] Average of '42 and '43 only. No weight records in other years.
[3] There is a note in the record for 1844, "Distemper in cows."
[4] Yield in 1850, weight not recorded in '49 or '51.

The steady increase in output was perhaps partly attributable to factors other than bones. Draining, we know, was going on all the while—the rent book shows numerous small allowances for drain tiles. It is improbable that the area of grassland was increased by seeding down of plough; for, as will appear presently, the proportion of arable was at least as high in the early days of the succeeding tenant as in 1829, and no measureable amount of cake or corn was bought. On the whole there seems no reason to doubt that the productivity of the farm was raised 50 per cent. by the lavish use of bones in the early years.

Later Victorian Times.

The progress of agriculture was stayed, in the middle of the century, by cattle diseases. Rinderpest played havoc in 1865 and 1866. Few counties can have suffered more than Cheshire, with its dense stocks of cows. Thos. Rigby estimated the losses, up to the introduction of compulsory slaughter, at 35,000 head. When the slaughter order was eventually made it not only further depleted stocks, but placed the burden of compensation upon local rates. Foot and Mouth, too, was prevalent in the next few years, and pleuro-pneumonia was a constant cause of anxiety.

Out of evil, however, some good came. The distresses of the times called forth the Cheshire Chamber of Agriculture—or perhaps it would be truer to say the hour produced the man, for Thomas Rigby, a tenant farmer of Darnhall Farm, Over, created that body. He was its first secretary, and for nearly 30 years its motive power. The pages of its minute book are at once an epitome of local farming history and a biography of a choice spirit. Its early debates were dominated by the idea of disease control; later it passed to consideration of other problems—labour, agricultural depression, foodstuffs, cheesemaking technique and, above all, dairying education.

As to labour, one resolution must suffice; it is symptomatic of much. It is dated 1872 and reads :—

> "That in the interests of the juvenile classes and in order to check loose and immoral conduct and to furnish farmers and others with a supply of servants it is very desirable and necessary that the

children of those parents who depend on wages for their livelihood should be compelled by law to follow some calling and to serve a master in some capacity until they have learned how to get their own living."

Discussions on cheesemaking were frequent. Changing technique, especially the growth of methods of manufacture resulting in a quick-ripening cheese, were debated. A chemist was hired to conduct experiments on making methods, and in 1894 a substantial grant from the Board of Agriculture was secured to continue this work.

The Chamber was a very active educational body. As early as 1875 its members financed a scheme for teaching agriculture in certain grammar schools; in 1886 they started a residential school of dairying at Worleston; in 1890 they appointed peripatetic lecturers; and in succeeding years they conducted a whole series of field trials. Their dairy school was in due course taken over by the County Council, and, as Worleston Dairy Institute, flourished for nearly 40 years. It persisted, indeed, until the post-War development of an agricultural education scheme centring in Reaseheath.

As to how tenant farmers fared during the latter half of the century we may judge from the records of Thomas Furber and his son.

Thomas Furber.

Another Thomas Furber succeeded to the tenancy of Brine Pits Farm on January 1st, 1854, taking over the whole of the stock and gear from his uncle, Thos. Leech, at a valuation of £1,300. No details are given of how this figure was arrived at, but it must have included nearly 40 cows and calving heifers, for the new tenant sold 31 calves in the spring months, and his purchases in the first year amounted only to one cow and one heifer.

Furber took over not only the stock; he took over the system of management too. His wife was already—or shortly became—a very accomplished cheesemaker. At the outset he ran the farm much as his uncle had run it. He had, perhaps, rather more sheep; his pig-keeping was not extensive, and the arable work was not formidable; the main business of the farm was the maintenance of the herd of spring-calved cows. Furber was keen on book-keeping. Day-to-day transactions were entered up in small cash books of pocket size—he must have used quite a series of them during his life, though I have only seen his first and last—to be transferred eventually to ledger accounts in a larger book. The manner in which the latter were kept indicates very clearly how he regarded farm finance. Calves, adult cattle, pigs, sheep and provender were regarded

as separate sections of his farming to be roughly costed each year. Thus his Cows Account for 1859–60 reads :—

Cows bought from May, 1859, to May, 1860.

1860.			£	s.	d.
Apr.	10	Bt. from Mr. R. B— 1 heifer	15	10	0
May	10	Bt. from Mr. S— 1 cow	14	12	0
„	12	Bt. from Mr. H— 1 cow	15	0	0
			£45	2	0

Cows sold from May, 1859, to May, 1860.

1859.				£	s.	d.
June	3	Mr. L—	1 cow	14	0	0
Aug.	13	Mr. C—	1 bull	7	15	0
Oct.		Mr. H—	1 cow	11	15	0
Nov.	5	Mr. M—	1 cow	3	0	0
„	12	Mr. H—	3 cows	22	0	0
1860.						
Feb.	23	Mr. W—	1 cow	8	0	0
Apr.	2	Mr. S—	2 cows	17	0	0
„	16	Mr. B—	1 cow	11	0	0
May	12	Mr. H—	1 cow	12	0	0
				£106	10	0
				45	2	0
Total made after enlarging stock 3 cows				£61	8	0

His calves account naturally consisted, as a rule, of sales only, but occasionally one was bought, in which case its cost was deducted from the gross profit.

In the earlier years of his farming life, all accounts for seed corn, as well as purchases of what are nowadays called feeding stuffs, were set out against his receipts from grain sold. Omitting detail the record for 1859–60 stands thus :—

	£	s.	d.
Bought wheat, oats and India Meal for 1859 and 1860	49	12	6
Corn sold, grown 1859 and 1860	281	5	2

Cheese was, of course, kept as a separate account. The record of sales is very complete ; but, curiously enough, there is no offset for materials.

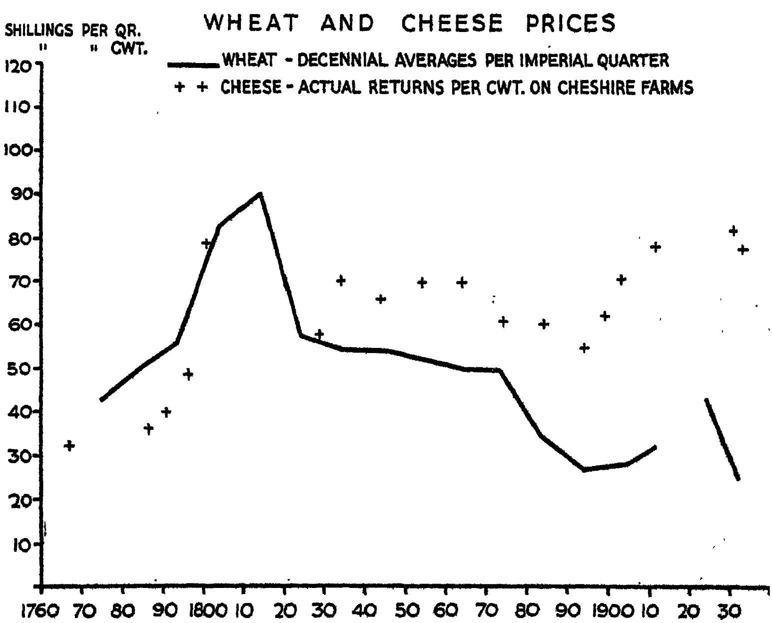
The labour records are apparently complete. In the early years the usual strength was two men at about £12 per year, two lads at £3–£6, one woman at £10, and two girls at £4–£6—all living in. Staff changes were very frequent. As a rule only one or two of the workers stayed for more than a year, and in no case during the first fifteen years did a man remain more than two years. In the period 1854–69 the names of no less than 43 males and 29 females appear in the wage records.

Misfortunes.—The farming of Furber's middle life, *i.e.*, during the '60's and '70's, was marked by two great misfortunes. In 1866 his stock was visited by the cattle plague. He records the disaster thus :—

"Sold no calves in the spring of 1866 owing to a visitation of cattle plague which commenced in the neighbourhood in the Autumn of 1865 but did not attack our stock till the 7th January 1866 by which we lost 31 cows 9 incalf heifers, 2 barren heifers, 1 year old calf for which the Land Lord Charles Wicksted Esq. allowed us £5 each extending it over three rent days, viz. £2 first, £2 second, £1 last."

How serious was this disaster one may gather from his returns. Like his predecessor in the farm, Furber had steadily pushed up his cheese output. From 111 cwt. in 1854 it rose steadily to 160 in 1861 and to 164 in 1865. In 1866 it was 19 cwt. only; receipts from calves also fell from £38 in 1865 to nothing in 1866.

Furber's reaction to this misfortune was probably characteristic of the times. He did not go straightway into the market to replenish his stock. He went first (as he records) to his landlord; and having got some help there, he commenced to rebuild his herd over a period of several years.



Gradually during the following years cheese output was raised to something like its former level. It reached 129 cwt., realizing £436, in 1871, and 138 cwt., worth £474, in 1872.

But in 1876 his wife was taken ill, a cheesemaker had to be employed, and for the rest of his life he was apparently dependent on hired help for this work. The cheesemaker is not so described in the wages account; at least not in so many words. What makes it clear that she was a cheesemaker is the fact that he describes her as Mrs. —— or Miss ——. (Traditionally this is the distinction in Cheshire between the servant and the

cheesemaker. The servant is known as Molly—the cheesemaker as Miss ——.)

The result of the appointment was an immediate decline in prices realized, particularly for spring cheese. Only once in 20 years had the spring cheese made less than 50*s*. Now, for several years, he had to accept 40*s*. or even 30*s*. The spring cheese in 1877 sold particularly badly, though not entirely by reason of its quality. He was offered 60*s*. per cwt., but refused the offer—and he eventually had to be content with 25*s*.

The Great Depression.—The late '70's and the '80's of last century were years of marked depression in British farming. Speaking generally, stock farmers fared better than corn producers. Furber's records, still quite as complete as in his earlier years, enable us to form a fair idea of conditions on cheesemaking farms.

Labour costs were of course rising steadily. £15 a year was paid to one man in 1879, and £14 to another in 1882. On the other hand his family were now growing up so that Furber could manage with fewer paid hands. In fact his total expenditure on labour was much lower than it had been 20 years previously.

Stock values were rising also, but, as always, Furber raised more cattle than he sold off, so that his cattle account was at least as favourable as in his earlier years. Corn prices had never seriously affected him—he had grown so little. In his later life he grew even less, most of the distant arable fields having by now been laid down to grass. Cheese prices held much more firmly than those of wheat. His average selling price in 1860–64 had been 69*s*. 6*d*. per cwt. In 1880–84 the comparable figure was 65*s*., though the average quality was probably lower.

A new factor was just coming into stock farming. The cheap transport which was lowering the price of corn was also bringing artificial foodstuffs in increasing quantities. Furber had always been in the habit of buying a little Indian meal—he bought 6 cwt., for instance, in 1860. Gradually his purchases increased, though they never approached the figures of modern times. Thus his books show in 1878—

	£	s.	d.
5 tons. 18 cwt. Indian Meal & Bran	46	8	1
4 „ 7 „ Linseed Cake	36	10	1

—large quantities by comparison with early years. Probably most of the Indian meal was used for pig feeding, though the farm never fed more than one pig per cow.

In order to get a clear picture of Furber's farming results, I have analyzed his books for the two separate periods 1854–57 and 1885–86, with the results set forth below :—

Expenditure.	1854–57 £	1885–86 £	*Income.*	1854–57 £	1885–86 £
Horses	—	30	Horses	—	37
Cattle	17	53	Cattle	73	146
Sheep	54	50	Calves	24	47
Pigs	5	16	Sheep	85	97
Corn	14	9	Wool	9	4
Meals	—	26	Pigs	71	53
Cakes	—	41	Potatoes	—	14
Labour	67	46	Corn	84	33
Sundry	9	—	Whey	—	20
Rent	286	286	Cheese	447	508
	£452	£557		£793	£959
Balance	341	402			

JOSEPH FURBER.

Joseph Furber had done a little farming "on his own" while still working for his father at Brine Pits. He had bought the whey and therewith fed pigs for a few years; probably he had done a bit of sheep farming also. In 1890 he married and took Moat Farm, Market Drayton, at a rent of 25*s.* per acre. It was a similar farm to Brine Pits, but 158 acres in area, some 30 acres being under the plough. His records were kept in great detail in a series of little note books, and he was engaged in writing them up at the time of his death a few months ago. His system of farming was essentially that of his father, but there were certain important differences. The grand period of boning was over; bones were too expensive; moreover, other manures were now available. Foodstuffs were being imported in ever increasing quantity. The urge to produce more still obtained, but the vehicle for effecting the increase was foodstuffs rather than manures. The cheese trade had altered. Regular sales of small amounts throughout the season had become common practice. And on the arable land a place was now found for turnips and other green crops.

Otherwise routine proceeded on Moat Farm very much as it had proceeded on Brine Pits. Mrs. Furber came of a noted cheesemaking family, while he was, above all else, a stockman. In the beginning two men, two women and a nursemaid lived with them in the house, and one man was engaged at day wages. Later, as the family grew up, two boys helped on the farm and two daughters in the house. The labour bill therefore amounted to £115 a year (plus the keep of five people) in 1892, and was only £50 in 1909.

Furber started with about 36 cows, but increased the stock to 60 in the first few years; he sold all his bull calves, realizing £42 a year thereon in the six years 1894–99. A herd of sows was kept, the value of stock sold therefrom rising steadily from £70

or £80 in the early '90's to £250 in 1912. They did not yield a very large profit however. For eight years (1898–1905) records were kept of their food consumption; and the annual balance amounts to but £20. Sheep were more satisfactory; 70 or 80 lambs (occasionally a few ewes) were bought annually and fed off in the following summer, leaving on an average a gross profit of £40 or £50. The dairy herd was maintained almost entirely by home breeding. Calves apart, sales of draft stock (which included some new calved) exceeded purchases by £110 per annum during the 16 years 1890–1905. Cheese naturally provided the main income. The price fluctuated from year to year, but on the whole tended to rise. Furber's sales throughout the '90's gave an average return of 57*s.* per cwt.; during the next five years they gave 64*s.*; in 1908 he got 72*s.*, in 1913 nearly 80*s.* His output rose from 136 cwt. in 1892 to over 240 cwt. in 1913. To provide the extra "keep" needed, manures were used fairly freely. Furber still bought a little boiled bones; and he tried a great variety of other manures. His expenditure on this head averaged nearly £20 a year throughout the '90's, and rose to practically £50 a year in the next five years.

There was, of course, a heavy bill for foodstuffs. It rose from £90 in 1890 to over £400 in 1903, and probably to £750 by 1913. But this increase was much more than justified by the cheese returns. In the following table I have set forth the returns from cheese and pigs, together with the aggregate expenditure on foodstuffs, so far as it is revealed by the books, in quinquennial periods. (The last two figures in the foodstuffs column have had to be estimated as the corn and cake accounts do not go beyond 1905).

	Income from Pigs	Cheese	Pigs and Cheese	Expenditure on Foodstuffs
	£	£	£	£
1890–94 . .	81	389	470	127
1895–99 . .	102	490	592	208
1900–04 . .	131	617	748	334
1905–09 . .	168	843	1,011	550 ?
1910–13 . .	250	1,006	1,256	760 ?

The War and Post-War Years.

The Great War brought to cheesemakers, as to others, a fitful fever of soaring prices which permanently increased the tempo of farming; in particular it stimulated the practice of buying cattle and pigs as well as foodstuffs to feed them on. It destroyed the already declining practice of boarding workers in the farmhouses; it converted, perhaps, one-third of the cheesemakers from tenants to farmer-owners.

The post-War years have been marked by falling prices and

steadily shortening labour supply, both paid and family. Rents now average about £2 5*s*. per acre.

Throughout last century cheesemaking in Cheshire steadily gave way to milk selling. By the '90's the northern part of the county had become definitely a milk-selling area. East Cheshire fell away next. At the time of the War perhaps half the farmers of the south remained true to ancient tradition. Since the War their numbers have fallen to about 300. The type farm which has characterized Cheshire for centuries has disappeared. The cheesemaker and vessel-cleaner may still board in, but all other workers are engaged on day wages, and the average farmer's cash expenditure on labour is four to six times that of his pre-War prototype.

Farmhouse cheese has become a luxury article. Strenuous efforts have of late been made to maintain a high standard of purity, chief among the steps taken, perhaps, being the formation of a Makers' Federation for grading purposes. The survivors differ so much in outlook, facilities for making and extent of other enterprises, that it is scarcely possible to sum up their present position in one paragraph. This much can, however, be stated with confidence. They were on the verge of extinction, prior to the Milk Board's subsidy in 1935, and in respect of their cheesemaking they live to-day by grace of that subsidy only. Other enterprises of course bring grist to the mill. Some winter milk is now invariably produced—usually for sale in liquid form. Pig-feeding is universally adopted on a scale which to our forefathers would have seemed fantastic. The following, based on a number of actual cases, may perhaps be taken as a fair average output of an enterprising cheesemaker on 200 acres, rented at £450 and importing some £2,000 worth of foodstuffs annually :—

	£
Cheese, 22 tons	2,000
Milk, 8,600 gallons	500
Pigs, 400 baconers	2,000
Sheep and lambs	100
	£4,600

A far cry from Thos. Furber's modest £125.

W. B. MERCER.

Cheshire School of Agriculture,
Reaseheath, Nantwich.

VEGETABLE PRODUCTION ON THE MIXED FARM.

VEGETABLE growing has only in recent years reached its present proportions and technique, and undoubtedly one of the chief changes in the structure of English agriculture has been the recent entry of the mixed farmer into this sphere of production. Since 1925 there have been wide changes in the industry, for although the number of specialized fruit and vegetable holdings has declined, there has been a great expansion in the total vegetable acreage, as can be seen from the following table :—

THE ACREAGE OF CERTAIN VEGETABLE CROPS, 1926-35.

	1926	1935	Percentage change
Carrots	8,341	15,750	+ 88·8
Cabbage (for human consumption) . . .	25,355	37,520	+ 48·0
Brussels Sprouts . .	25,468	34,083	+ 33·8
Cauliflower and Broccoli .	13,295	19,538	+ 47·0
Celery	5,366	6,350	+ 18·3
Rhubarb	6,410	7,547	+ 17·7
Beans (picked green) . .	12,628	20,678	+ 63·7
Peas („ „) . .	46,425	90,528	+ 95·0
Total . .	143,288	231,994	+ 61·9

Certain counties are particularly associated with these changes. Cabbage for human consumption has increased in Norfolk from 750 acres in 1926, to 2,753 acres in 1935 (267·1 per cent.), and in Bedfordshire from 561 acres to 1,674 acres (198·4 per cent.) over the same period. The brussels sprouts acreage has increased by 774 per cent. in Norfolk, by 230 per cent. in Gloucestershire, and by 108·8 per cent. in Cambridgeshire. The Cornish broccoli crop likewise has been extended by 111 per cent., while peas picked green in Norfolk have increased ten times. Further examples could be quoted from an examination of the agricultural statistics, but the main points to be noticed are :—

(1) The chief vegetable areas are now located in Lincoln (Holland and Lindsey), the West Riding of Yorkshire, Essex, Kent, Bedfordshire, Norfolk and Worcestershire.

(2) There has been a great expansion of vegetable acreage in the Eastern Counties, particularly in Norfolk and Lincolnshire.

(3) There has been a general extension of vegetables in nearly all counties.

(4) The vegetable acreages in Wales and the North of England still remain very small.

The causes of this expansion have now to be examined. Naturally, the chief reason is financial. It is not that the prices of vegetables have risen rapidly over the period, but that the prices of other farm products have fallen much more precipitously; farmers have been driven by years of disastrous experience of the normal arable farm routine (especially before the introduction of the Wheat Subsidy) to find alternatives.

The following table[1] shows the position in recent years and illustrates particularly the superior position of vegetables.

THE INDEX NUMBER OF WHOLESALE AND AGRICULTURAL PRICES, 1927–35. (1911–13 = 100)

	"Statist" Index of wholesale prices of all commodities	Agricultural Index	Cereals	Live-stock Products	Fruits and Vegetables
1927–9	143	145	133	149	168
1930	115	134	106	147	121
1931	100	120	86	127	134
1932	96	112(114)*	87	114	175
1933	95	107(111)*	83(113)*	115	143
1934	98	114(119)†	84(109)*	122(123)§	132
1935‡	102	117(123)†	97(109)*	121(126)§	184

* Including Wheat Payments.
† Including Wheat and Cattle Payments.
§ Including Cattle Payments.
‡ Provisional.

Just as the corn grower of the 'nineties was forced to turn his attention more towards live stock, and the stock breeder after the War had to change over to milk production, so to-day farmers are turning their thoughts towards vegetable production. The milk market is overflowing and prices are declining, in spite of subsidies paid to cheese-makers and other milk manufacturers; but now that Import Duties restrict the entry of vegetables from Europe and the Canary Isles, prices in this field of production appear more attractive.

Many farmers began by growing a few acres of vegetables as a makeshift until times became better. The comparatively good prices provided a cash income, and the vegetable crops provided a means of keeping the land clean and in good heart. What was thought of as a temporary expedient has, however, shown signs of becoming permanent, and is being more and more widely adopted.

The price factor is undoubtedly the reason for this big expansion, but there are many dangers facing the newcomers. The crude annual price indices for the individual products

[1] *The Agricultural Register*, 1935–36, p. 207.

demonstrate the big variations in prices that occur from year to year, but do not show the fluctuations that occur from week to week, or from day to day. For example, the price of brussels sprouts in the first week of September, 1932, was 4*s.* 6*d.* per pot, while in October it was 6*s.*; it had declined to 3*s.* by the first week of November and to 2*s.* 3*d.* in December. In 1933, the prices of cauliflowers ranged from August to December as follows: 2*s.* 6*d.*, 3*s.* 6*d.*, 5*s.*, 3*s.* 6*d.*, 5*s.*

It can be appreciated, therefore, that there is a speculative element in vegetable growing, and farmers have felt their way gradually, increasing by a few acres at a time.

Besides the price factor, there are local reasons for the spread of vegetable culture to big farms. The "sickness" of the land, particularly in small-holding areas, has been an important cause. In East Anglia, particularly in West Suffolk, some uncertainty about the future of the sugar-beet industry has contributed. A few enterprising men took to growing vegetables on an extensive scale in the fear that the beet subsidy might be withdrawn altogether or drastically reduced. They thus became less dependent on the subsidy, besides getting well entrenched in the production and sale of vegetables against the time when a cessation of the sugar-beet payments might cause a stampede into vegetable growing. In other areas the influence of education and official encouragement is plainly to be seen. On many farms in the South of England there is a younger member of the family who has been trained at an agricultural college. The influence of the County Agricultural Organizers of Bedford and West Suffolk, too, has very obviously stimulated the new movement in their respective counties.

All these influences have been aided by the fact that vegetables fit very easily into the ordinary farm routine and offer great economies of integration. This is one of the major causes of the present plight of those smallholders who rely on vegetables and fruit for a living, for some of the additional vegetable acreage on mixed farms has undoubtedly been at the expense of small men who have not been able to compete with the new large-scale producers. The following analysis illustrates the various ways in which vegetables can be fitted into the farming system, enabling more efficient production with hardly any additional requirements.

(1) *Supplies of Manure.*—The farmer has always a good supply of manure from his animals, and therefore is never stinted, even in times of low prices, of this primary necessity for good vegetable growing. Moreover, the dung produced by cattle contains valuable humus, and thus the soil is easily kept in good condition. The difficulty of getting organic manures, and the large dependence on artificials, is one of the chief reasons of the impoverished

condition of the vegetable district of East Bedfordshire and other old specialized vegetable areas.

(2) *Crop Disposal.*—The mixed farm provides an alternative outlet for vegetable crops if ordinary methods of disposal fail. If prices are good (as they were, for example, in 1935–36), the farmer has no difficulty in selling his vegetables. If prices are only fair he need send to market only so much produce as will fetch the cash that he needs, since he, unlike the small grower, is not entirely dependent on direct sale. The balance of the crop he can usually fold to sheep, thus saving labour costs in picking and, later on, in dung spreading; or he can cut the greens and cart them to the cattle yards.

(3) *Labour.*—Another great economy is in the better use of labour. The farmer, in the past, has required his biggest labour force in spring and harvest. In winter men were frequently "stood off" for some weeks at a time. The introduction of vegetables evens out the distribution of work over the year, for such crops as brussels sprouts, cabbage, white turnips and carrots mature in the winter months and require many pickers. These vegetable crops are planted either between hay-time and corn harvest, or immediately after the latter, so that "slack" time is utilized. The planting, cleaning and picking do not require much specialized skill beyond the speed that comes with practice. The technique of cultivating seed-beds for cabbage and of planting and hoeing the crop, for instance, is little different from that used for kale, which has long been grown for stock-feeding purposes on many farms. It is obvious, therefore, that, in fitting these vegetable crops into his organization, the farmer improves the utilization of his labour force.

(4) *Use of Farm Machinery.*—Another factor of production which is used more efficiently is farm machinery. The mixed farmer can use his ordinary modern implements for vegetable production. Thus tractors, roto-tillers and even the ordinary horse machinery are utilized more fully than before, reducing the overhead costs of cultivation for all farm products. Another advantage of the implements used by the large farmer is that much greater speed in working is obtained. This is of special importance on heavy land. Clay soils were impossible for certain vegetable crops before the time of the tractor, as the horse plough took too long for cultivating them even in the best of weather. Again, a big farmer can afford to run his own lorry to the wholesale market, or even to retail distributors. The lorry can be used on the farm all day, and at night it can run produce to the nearest big market, returning often with a load of farm requisites. Control over the means of transport is a great help to the farmer, because picking and grading need not be rushed in order to catch a certain train. Direct motor transport also

avoids repeated handling, which not only means high distribution costs but tends to rob the vegetables of their freshness.

At the same time, although vegetable production fits very well into the routine of mixed farming, it calls for certain adjustments.

The effect of vegetables on the farm routine has been revolutionary only on a few farms, for although the total changes over the last ten years have been very great, they have been gradual. Some of the main changes are noted below, but it must be remembered that the process of evolution is still proceeding, and that the points mentioned may not in all cases be applicable to any but a particular area.

(1) *Changes in Rotation.*—One of the most noticeable features of the information obtained from the farmers in the course of this survey was the very flexible form of the rotation used, which varied in an opportunist manner from year to year. There appears to be no stereotyped rotation on the vegetable-growing farms. In some parts of Bedfordshire, on heavy soils, there was a five-course shift, but in four instances, in Oxfordshire, the vegetables were grown in the same field year after year. In Devon, under the County Council scheme for growing Roscoff cauliflower, a long rotation from five to seven years has been advocated, the most suitable places for the crop being one of the following :—

(*a*) After a short ley, taking the place of barley, etc.
(*b*) Replacing spring corn after a well-manured wheat crop.
(*c*) Replacing a root crop following corn, where a half fallow is required for cleaning purposes.

Some farmers, since 1931, have made wheat the centre of their systems, and regard their vegetables partly as a useful sideline and partly as a means of getting the ground into good condition for corn. In West Suffolk, sugar beet is still the sheet anchor on most farms, and nothing is grown which will interfere with this crop, especially during the lifting season. On some farms in North-East Gloucestershire and Bedfordshire, on the other hand, vegetable production has tended to become the chief object of the farmer, and such crops as wheat are regarded as subsidiary.

Generally speaking, however, it is fairly certain that the chief changes of cropping have been the displacement of roots, horse beans, bare fallow and possibly grain crops by vegetables, although, since the introduction of the Wheat Subsidy, the displacement of wheat has ceased. The degree of change naturally varies from farm to farm. It has been noticeable that although some farmers are growing less clover and rotation grasses, only one of the men interviewed has ploughed up permanent grassland

in order to grow more vegetables; and he was progressing rapidly in the direction of becoming a market-garden specialist.

These rotational changes have generally been effected without any ill-effects, as the type of vegetables grown, usually the brassica family, fits well into the general run of farm work. The danger with winter vegetables is undoubtedly the risk of a late clearance. If sprouts or spring broccoli happen to be late, owing to weather conditions, there is a grave risk, especially on the heavier soils, that cultivations for barley or spring wheat will be so retarded that these crops will be seriously hampered or perhaps not sown at all. The consequent fallow or catch crop is not only a serious financial loss compared with a crop of corn, but it makes a bad break in the farm organization.

The changes in cropping have not led to revolutionary changes in the numbers of animals maintained. By far the majority of farmers report that there have been no changes in stocking due to the development of market gardening. The loss of roots has not led to a reduction in the number of sheep, but only to changes in the breeds of sheep, and to adjustments in feeding practice. More "grass" sheep are being kept instead of the bigger "arable" sheep. Some farmers actually keep more sheep, in the form of flying flocks used to mop up their unsaleable greenstuff, than they did in the past.

Similarly, the number of store or fat cattle has not suffered from the reduction in fodder crops. This has been particularly noticeable in the Eastern counties, where sugar-beet pulp is now widely used as a feeding stuff. It is the opinion in West Suffolk that the growing of vegetables has contributed to the maintenance of cattle feeding in spite of the low beef prices prevailing, because the making of dung for the vegetable crops is so important. The reduction of the cereal acreage and the demand for much manure for vegetables has led, on some farms, to the purchase of large quantities of straw. The general effect of market gardening on the number of fattening cattle has thus been to enable the farmer to maintain his numbers, which otherwise would probably have decreased in view of the poor price of beef.

(2) *Changes in Labour.*—It is in respect of labour that the most interesting changes have occurred. Whether any new men have been employed has depended on the area of vegetable crops, on the size of the farm, and on the other farm activities. Thus no general estimate can be given of the extra labour required for a given acreage of vegetables. It is certain, however, that more labour is required when vegetables are grown, even if such may be provided entirely by casual workers or by overtime; apart from the more efficient use of existing men, there has been created on many farms a demand for extra labour. Most of this is wanted in the winter season—a distinct reversal of the old state

of affairs when extra men were wanted only in the peak periods of hay and corn harvests.

The demand for labour appears to be one of the key points of vegetable growing on mixed farms, for an inadequate supply of workpeople is one of the main limiting factors to further expansion in many districts. Nearly everywhere there is evidence of a labour shortage, even where good piece rates, instead of the average minimum weekly rates, have been offered. In Bedfordshire the labour question is very acute. The country from Woburn to Bedford has been turned into one vast brickfield, owing to the building boom, which development has created a big demand for labour. The wages offered have been far in excess of those obtainable on the farms, and there has been a migration of workers from the vegetable to the industrial areas. This drain has been all the more noticeable because the brick industry has developed very suddenly, following the working-out of the Peterborough brickfields and, in spite of the good building material available, very few houses have been built to accommodate possible workmen from other areas. Thus there has been competition for the men already housed in the adjacent areas. Skilled agricultural labourers have moved into unskilled work in the brickyards, while experienced manual workers from the mines of the North have been transferred not to the clay pits of the brickyards, but to small holdings in the heart of the vegetable country. The growth of public works on roads, etc., has also drained away much labour from Bedfordshire farms.

In Sussex and in parts of Kent, too, vegetable growing has been restricted to very small acreages on farms, owing to the same scarcity of labour.

In the newer vegetable areas of East Anglia, this scarcity of workers is not so apparent, except in a few instances where Government aerodromes or road works have caused a temporary shortage. This relative abundance of labour is probably due to the importance of the sugar beet industry in the area. There is also a good supply of village women who like the novelty of picking peas and beans for a few hours a week in the summer, and who are quite willing to go to the fields at a moment's notice to make some pocket money. In the few small vegetable areas in the river valleys of the North, there appears also to be a supply of cheap woman labour.

The general shortage of labourers has led to some extraordinary conditions. The well-established vegetable districts have long been on piece-rates. The labourers of the Biggleswade and Sandy areas have acquired amazing dexterity in planting and picking sprouts and now hire themselves out in gangs to farmers outside the true "market garden" areas, travelling as far as Baldock in Hertfordshire. There are obvious drawbacks

in being dependent on workpeople from other areas, but the market garden workers appear to have some slack time in most seasons, and are most useful to the mixed farmers in adjacent districts.

In some districts a labour force has been organized co-operatively. The East Essex Farmers, Ltd., for example, undertakes the lifting and marketing of the crops of over a hundred farmers. Gangs of pickers, composed of local people, Londoners and gypsies visit the fields as required, each gang being in charge of one man, who is responsible for the clearing of the crop.[1]

Nearly all districts, however, gladly accept any available labour. Labour Exchanges in the industrial towns of the North and Midlands experience a marked reduction in the numbers of unemployed on their books with the advent of the pea-picking season in Yorkshire and Lincolnshire,[2] and special arrangements are made by the authorities with these unemployed men. Essex draws men from the East End of London, and Worcestershire relies on the Black Country for extra labour. Tramps are used for potato lifting and brussels picking, and some farmers employ the same men every season, providing "Nissen" huts for them in the fields. Gypsies, too, are widely used for the seasonal work, not only on the East, but on the Northern Cotswolds; opinions vary, however, as to the quality of this labour. Immigrant Irish "sugar-beet" men are another source of labour; while in Suffolk, itinerant Scotsmen from the North-East searching for work are greatly prized owing to their readiness (by contrast with local labour) to work in all weathers.

One method of getting through the labour programme is to encourage the existing staff to work harder and to put in overtime, and this has been effected by adopting piece-rates for certain operations. This practice has had wide repercussions in some districts of Bedfordshire. Some milk farmers, not particularly interested in vegetables, have felt themselves obliged to grow brussels sprouts in order to give their men opportunities of earning extra money and so to remove the temptation presented by neighbours who have plenty of piece-work to offer. On several farms this practice has spread to all farming operations except haymaking. In another district, more famous for stock-raising than for market-gardening, one farmer has tried to start fruit-growing near an expanding industrial town where there is a good market; but he was unable to extend his operations very far because his men regarded fruit-picking as women's work, and would have none of it. Yet another example of the extraordinary conditions that prevail is provided by a Hertfordshire farmer who has to go

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[1] Green Peas, p. 49, *Bulletin of the Ministry of Agriculture.*
[2] *Ibid.*, p. 16.

ten miles to the nearest railway junction twice a day to get his men, who come from Bedfordshire. Sussex fruit farmers, too, have to run lorries to collect their workers from scattered villages.

Work with vegetables does not necessarily require long periods of training, for dexterity is easily acquired. Work with small fruit requires longer experience. Farmers naturally prefer new men to be as young as possible, but for piece-work nearly all comers are welcomed. A fairly efficient sprout picker earns about 45*s.* a week, which sum exceeds the average minimum wages earned by skilled men in other branches of farming; the best men earn up to £4 a week. The rates paid for other operations vary considerably according to the time and skill required, payment for the "knee work" of carrot lifting being different from the acre rates for weeding cabbages or setting sprouts.

It must be noted, however, that employment in the vegetable fields is not so attractive as other branches of farm work. The wages, it is true, are comparatively good, but piece-rates, while acting as a spur to the efficient, make a new kind of slavery. The pea and bean pickers in the summer enjoy the best of the summer weather, and the women are all the healthier for the sun and the fresh air; but in winter the attractions end. "Bad weather is a good vegetable salesman," and supplies must be maintained even under severe weather conditions. It is arguable that piece-workers can please themselves when they work, but the "boss" often requires his supplies urgently, and sees to it that his gang does not lose much time. On the other hand, it is true that between "seasons" the piece-worker can have a day or two off, whereas the milker and the shepherd have a seven-day week.

Another drawback against vegetable work is that it is uncertain. Labour is urgently required when prices are good, as in the years 1934–36, whereas in times of slump not more than one picking is made before the peas are ploughed in or the sheep are turned on to the cabbages. Before workers can be encouraged to migrate, even from the depressed areas, some better prospect must be offered than that which the people already have. There must be housing accommodation, and the assurance of fairly regular hours and wages.

(3) *Changes in Capital.*—Most changes of farm policy involve the question of extra capitalization. A change from cattle feeding to milk, for example, involves the expenditure necessary to replace stockyards with milking sheds, while an increase of poultry or pigs also requires new equipment. A change in arable operations, however (apart from mechanization), involves no radical change and consequently but little new capital is needed. Most of the necessary implements are already available, and apart from one or two smaller implements for special jobs, no

great change of equipment is necessary. This fact has favoured the increase in vegetable growing during a period of economic depression. Not only has the amount of extra capital been small but it has been "liquid," *i.e.*, the investment has been mostly over a short period only.

Most farmers have scarcely noticed the need for extra capital, for they have proceeded cautiously with a few additional acres each year, financing each increase out of the profits of the preceding year. Extra capital, however, is undoubtedly necessary. Vegetables require extra manuring and more elaborate tillage as compared with the ordinary arable crops, and the gathering and marketing of the crops necessitates more ready money to pay wages. The extra outlay, however, soon returns to the farmer's pocket. In brief, there is no great strain on the farmer's financial resources.

The marketing of vegetables involves certain extra costs, even if a home-made sieve for grading sprouts is used and there is already a farm lorry available for carting. Sacks or boxes must be used for sending the produce to market. The typical mixed farmer with a few acres of vegetables—easily the most common type of grower—keeps his production within moderate bounds and markets his produce in bags or nets. For transport he either relies on a contractor, or takes turns with neighbours in sending his lorry to Covent Garden, or again takes his garden stuff, in a trailer or with his milk, to the nearest market town. Farmyard manure is his principal fertilizer.

(4) *Changes in Machinery.*—Naturally, the serious labour shortage, together with the necessity of the extra work usually entailed with vegetable growing, brings up the subject of machinery. Here again the extreme range of farm types and sizes, and the varying extent of the vegetable areas, make it impossible to define common tendencies. It is fairly certain, however, that only those farmers who have taken up vegetables on a large scale have made any great change in their equipment.

The use of large machines in the production of crops with a high cash return has greatly reduced overhead costs, particularly where the land was previously cleaned by bare fallowing. Another big advantage of the mechanized farm is that a much greater working speed is obtained.[1] The big farmers drill seeds in the field instead of sowing in a seed-bed, thus avoiding the extra trouble of transplanting. Direct sowing is a common method of growing cabbages and savoys. Tractors with "Miller" wheels may be used for ridging up and also for "spinning" potatoes and thus expensive horse and hand labour is saved. Most important of all is the large-scale machinery which has been devised to replace the dibble and the hand hoe. Mr. C. T. Joice

[1] See p. 93.

of Fakenham uses a Morris motor car fitted with hoes, which can cultivate either in 36-, 24- or 18-inch spacing at a speed of 1½–2 acres per hour.[1] Bomford's selective hoe for inter-plant cultivation does 7 acres of sprouts in a day, displacing the labour of twenty casuals. The Transplanter, drawn by a Caterpillar Ten tractor, can set as many as 150 plants per minute, employing three or five men according to the spacing of the plants.[2] A Farmall outfit is also an effective labour-saving device for crops on level ground, while another common device for hoeing is the light tractor with the necessary steerage and hoe auxiliaries.

Big strides in labour reduction have thus been made on the cultivation side, both by agricultural engineering firms and individual ingenuity, but harvesting appears to have advanced little through the development of machinery. The picking of cabbages, savoys, brussels sprouts, beans, peas and broccoli does not seem to lend itself to mechanization. The inherent difficulties in the way of mechanization of harvesting processes are, firstly, the care with which these delicate products have to be handled and, secondly, the varying times and states of maturity. For example, cabbages do not all grow to the same size and all the beans on a stalk will not be ready at the same time. On big Lincolnshire farms, peas for canning are sometimes mown and the entire crop carted to a riming machine (a modified type of thresher), but this method has limitations in the rather inefficient handling of the crops and in the high capital cost of the machine.

It is certain, however, that the mixed farmer has a decided advantage over the small grower in the greater possibilities of mechanization that are open to him. The many adaptations of the ordinary power implements of the farm have enabled him to make big increases in the acreages of vegetables with much lower labour costs than those of the small man.

(5) *Changes in Manuring.*—As indicated elsewhere, manures play a most important part in the growing of vegetables. The mixed farmer is in a relatively strong position owing to the supplies of dung at his immediate disposal, and while the small growers of Morpeth can use the town refuse of Newcastle, the smallholders of Bedfordshire and Worcestershire are not so fortunately placed, and rely chiefly on artificials or green manures, such as mustard. There can be no doubt that the application of humus, besides feeding the plants, gives decided advantages in the aeration of the soil and the improvement of its mechanical condition. The liberal use of farmyard manure is the only common feature in the manuring of vegetables on the mixed farm. Otherwise nearly every farmer has a different combination

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1 Rothamsted Conferences XV.

2 C. S. Orwin, "Pioneers of Power Farming," p. 20.

of fertilizers adapted to his ground and his rotation. In Bedfordshire, soot is commonly used on many farms, although there are some men who have decided objections to its use. Soot users say that its mechanical action on the soil is good, and that it imparts a dark green colour to the vegetables. On the other hand, it is argued that soot gives nothing valuable either to the soil or the plants, that proper tillage operations would give adequate aeration, and that ordinary artificials are less costly.

Manuring is closely related to cultivation and rotation. With well-tilled land and a good rotation of crops it is possible to avoid most of the diseases and pests which threaten to overwhelm certain specialized areas.

(6) *Changes in Marketing.*—Probably the most important side of vegetable growing is the final marketing of the product. The most common method, perhaps, is to sell direct to shops. This practice is followed all over the country, particularly by small dairy farmers who can take vegetables daily on their milk trailers into the local towns. This trade may be small, but it provides the farmer with some useful petty cash and reduces the cost of milk delivery.

Another popular form of marketing, especially by those men on the fringe of vegetable growing, is by sale in the ground. This has the special attraction that it avoids most of the labour problems that face the farmer, while he escapes, also, the extra cares and troubles of marketing. Naturally this "selling in the ground" is important only in times of high prices, when merchants begin to look afield for more supplies. In seasons of good supplies there are sufficient quantities coming on to the market, and the wholesaler is not inclined to go to the extra trouble of buying in the field. Farmers who are not prepared to market their produce consequently tend to grow "dual-purpose" crops, so that there will be no great loss if these are unsaleable.

Yet another form of sale used by people who have just entered vegetable growing, and one which is closely allied to sale in the ground, is that by pre-arranged contract. This method shows signs of increasing, especially now that the old-established vegetable districts are showing signs of soil "sickness." Growers with well-established connections, rather than be short of supplies, place contracts in "maiden" outlying areas. Canning factories also seek farmers with whom to place advance orders, so that some regular flow of raw material is ensured. The certainty of an income and of a market has been most attractive to arable farmers during the depth of the depression; yet often, as experience has been acquired and curiosity whetted as to the final profitability of vegetables, these men have tended ultimately to enter the ordinary marketing channels.

A more advanced step in the farmer's selling technique, and one which is widely followed in some well-developed vegetable areas such as Worcestershire and Bedfordshire, is sale to a dealer. In this system the farmer undertakes all the work on the farm, from seeding to packing, and then sells to a specialist who undertakes the functions both of transport and of sale—either on the wholesale markets or straight to shopkeepers. There are some advantages in this method. The farmer is saved all the work and worry "off the farm," while, if his dealer is a reliable person, he obtains fair prices and he knows within reasonable limits the quantities that he will be required to deliver day by day. The disadvantage is the entry of another middleman, who may, unless the farmer is careful to have alternative means of selling, develop into a monopolist and who may be able to exploit the farmer's lack of intimate market knowledge to make occasional big profits. On the whole, however, farmers like this form of sale because it saves much labour and trouble.

Probably the most popular sales service, however, is that provided by commission agents. The farmer has, indeed, in this case to keep in constant touch with the market about prices and supplies, and although the telephone has done much to overcome the distance between the farm and the sale ring, he is rather apt to suffer from the lack of personal contact with his salesman.

Some farmers believe that there is a tendency towards exploitation by salesmen acting in association. This is a common complaint in most spheres of production, which cannot often be substantiated. It is a significant fact, however, that most of the big producers use several agents and markets, and appear to visit each at least once a week during the winter.

(7) *Changes in Transport.*—Recent developments in transport have been an influence in the increase of vegetable growing. The prices received for these highly perishable crops depend very largely on their freshness. Before the War only those farmers who were near to railway stations, or who were near enough to wholesale markets to deliver by horse and cart, could grow vegetables. In well-developed market-garden areas the rail transport was well organized, but the disadvantages from the farmer's point of view were the cost and the deterioration in quality when the goods had to be handled on the farm, at two railway stations and again at the market. There was also the drawback of the rigidity of the railway time-table, which at times was likely to interfere too much with the ordinary farm routine.

The advent of motor transport has revolutionized vegetable marketing, for produce can now be taken direct from farm to salesman or even direct to the shop, almost at the convenience of the farmer. The great bulk of vegetables now appears to be transported by road, rail being used only by those farmers who

are at a long distance from market. A noticeable feature of the industry has been the appearance and rapid increase in the number of road contractors. These men are either pure carriers, who make up loads from those farmers who have relatively small acreages and only small daily consignments, or else they are the contractor-dealers.

SUMMARY.

What is the future of vegetable growing? Will the recent phenomenal increase go still further? The 4th June figures for 1936 showed that the areas under vegetables for human consumption were greater than ever before. Cabbage increased by 6,000 acres (16·0 per cent.); brussels sprouts by 900 acres (2·6 per cent.); cauliflower and non-sprouting broccoli by 1,000 acres (5·1 per cent.); and carrots by 1,100 acres (7·0 per cent.). It is quite clear, indeed, that the present expansion cannot go on indefinitely unless there is more certainty about prices, for there is a limit to the fluctuations which even the mixed farmer, with alternative methods of disposal, can stand. In 1935 and the winter of 1936 prices were extremely high, owing mainly to the extraordinary weather conditions; and even turnips intended for sheep feeding were bought by dealers, for the sake of their tops. By August, 1936, however, prices were coming down with a rush. One farmer of Coggleshall, Essex,[1] after paying picking, carriage and salesman's expenses, had 1*d.* per bag of 40 lb. of runner beans, while at the end of the month fruit was being given away at Droxford, Hampshire. Such price conditions may ruin smaller people outright, and give even the mixed farmer food for thought; the acreage under vegetables may not continue to expand at the present rate.[2]

Much depends on the relative prices of other farm crops. If cereal, beef and milk prices continue to fall, then farmers will not hesitate to gamble on the vegetable market. The increasing acreages of recent years must be taken as an indication that vegetables pay their way, otherwise so many people would not rush into this sphere of production. It is certain, however, that the old state of equilibrium, which existed when the vegetable trade was chiefly in the hands of small men, has disappeared. Formerly these men were continually being faced with the question of increasing or decreasing the acreage of each crop. If prices were good, should one extend one's acreage, and then, almost certainly, if everybody did the same, depress prices the following year? If prices were bad, should one decrease one's acreage, and then miss the opportunity of good prices if one's neighbours did the same? Such questions do not seem to have

[1] Letter to *News Chronicle* by J. W. Moles, August 20th, 1936.
[2] Figures for 1937, indeed, show some marked decreases.

been closely considered in recent years by mixed farmers. The considerations which have made for a rapid expansion in vegetables have mainly been the unprofitability of other crops. If cereals, fodder crops and bare fallow have not paid, why not try vegetables, which may give good returns, and certainly cannot do worse than the crops which they replace?

Propaganda, by doctors, dieticians and scientists, advocating increased consumption of fresh fruit and vegetables may cause an increased demand for these products, and with a rising standard of living there can be no doubt that more fruit and vegetables will be needed. The main question is the cost of distribution of the products. It is a popular topic of discussion among farmers that cabbages, which leave the farm at three a penny, are sold to the public at from 3*d*. to 4*d*. each. Some kind of marketing scheme is probably necessary to supplement the widespread health propaganda and to safeguard some of the interests of the farmer.

A factor which seriously affects prices, and the efforts to control prices, is the weather. Its importance during the growing season of a vegetable, especially during its early stages, is obvious. Severe drought or early frost can devastate whole districts and thus upset future prices. But the climate exerts an additional influence on vegetables over and above these last effects which indeed are not confined to vegetables. While hot or cold weather does not cause enormous variations from day to day in the consumption of bread, it has a great effect on the demand for vegetables. Cold weather in winter creates more demand; the average Englishman's midday meal consists of meat and two vegetables, but an extra cold snap results in a change to soups and stews, which require a much bigger variety of vegetables. In summer a sudden hot spell results in a big rush for salads of all kinds, and while this partially spoils the market for peas and beans, the extra sales of lettuce, cucumbers and tomatoes more than compensate for this. Unfortunately these changes cannot be predicted, and thus the market is open to great fluctuations. Weather conditions, therefore, play a large part in determining vegetable prices, and until there is a more scientific advisory service, farmers will still have to supply the markets blindly.

It is sometimes thought that the canning industry will eventually remove some of the farmers' difficulties by absorbing large supplies and thus evening out prices. In actual practice, however, it seems that canneries offer no permanent solution at all. The chief difficulty of the canners is the same as that of the grower—namely, the wide fluctuations in supplies and demand. These make it difficult to forecast the volume of the season's pack, and there are consequent variations in the prices of the finished products. These in turn vitally affect sales, for one of the

chief selling points with canned articles is standardization of price.

Factories, again, want large quantities contracted for in advance. This is an advantage to the big farmer, because canners and jam makers prefer to take produce from large consignments rather than have numerous dealings with small holders; yet the prices offered are often not so attractive as those prevailing in the ordinary market, and thus farmers have always the temptation of selling independently. When the canneries buy in the open market, they are again faced with the risk of extreme price variations. In times of scarcity, everybody is selling on the open market and prices are high. On the other hand, in times of glut, the factories can obtain ample supplies almost at their own prices.

But if the canners do not offer a permanent or complete solution of the problem, they do help to even out price fluctuations. Canned goods provide effective substitutes if the prices of the fresh vegetables rise too high. It has indeed been said that English farmers must grow things which the foreign competitor cannot supply, and vegetables have been mentioned as one class of such products. But just as English milk prices are determined to some extent by the amount of imports of butter, cheese and other milk products, so will the price of fresh vegetables be determined by the amount of tinned vegetables on the English market. There is thus no real monopoly for home farmers; they must face the fact that the vegetable market may soon resemble the milk market. There will be those fortunate growers who can exploit the "liquid" market, and those growing for the manufacturing market with envious eyes on the former. Eventually the competition of home and foreign canned goods must limit the profitability of the "fresh" market and, if the farmers are not to compete too fiercely with each other, there must be some organization to control the market before the industry gets too large and unwieldy.

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COMPLEMENTARY PROBLEMS IN THE MANAGEMENT OF DAIRY HERDS.

Eradication of Disease and Breeding Policy.

During the past fifteen years the writer has been responsible for the management of a herd of 24 Dairy Shorthorns, a privilege which has been fruitful in problems and opportunities. The aims have been, first, to measure the extent of each problem; second, to determine whether the same problems are common to other herds; and finally to evolve and test measures of control capable of general adoption. Very early in the history of the herd the simple maxim—use a pedigree dairy bull, rear selected heifer calves out of the best cows, and so raise the status of the herd till the crown of pedigree is won—had to be adjusted to the facts. The life of the cow is too short to give scope for much selection of calves, and events in the Institute herd, together with those on another farm (Ref. 1) and in large-scale surveys (Ref. 2), dispelled any tendency to look on dairy herd management as conformable to a simple formula. Two fundamental problems became apparent, namely the reduction or elimination of wastage through disease, and the need to take every possible precaution to ensure that heifer calves born in healthy surroundings would, by virtue of their inherited qualities, justify the expense of rearing when they joined the milking herd.

Health control led to the application of the tuberculin test and the blood agglutination test for abortion. For eight years tuberculin testing was carried out at intervals of a year or longer as a guide to the selection of drafts, but without immediate disposal or complete isolation of reactors. Then followed two years in which tuberculin testing was vigorously prosecuted at frequent intervals in order to "clean up" the herd. A Grade A T.T. licence for four years completed the period under review, although since then the herd has become attested.

For two years endeavours have been made to control abortion by segregating reactors from non-reactors so far as this can be done on a farm with one cowshed. During this period the milk of each cow has been subjected to a colour test at regular intervals to assist in the detection of mastitis.

On the breeding side the need for drastic action became apparent when home-bred heifers failed to fulfil the expectations based on the performance of their dams. Fortunately at this time an opportunity arose of taking part in field trials of a proposed system for the progeny recording of dairy sires. The evidence collected (Ref. 3) stimulated the decision that something

must be done to demonstrate a method of bringing progeny records into practical use. Since the use of proven sires is impracticable in all but a few herds, it was argued that some other way must be found of utilizing progeny records in the selection of breeding stock. The method adopted involved the selection of bull calves bred from sires which had been proven by the milk yields of their daughters and from dams which had been inspected and approved. These calves were reared, in surroundings relatively free from T.B., on the Institute farm. At sale time the progeny records of the sires were brought into the milk pedigrees, which became balanced by milk records from both sire and dam, and an old and very sound principle was revived.

At this stage it seemed desirable to investigate the manner in which milk records were used in sale catalogues, an investigation which brought to light a state of affairs which can only be described as highly unsatisfactory.

Thus, the management of a small herd of dairy cows had led (*a*) to the collection of many data regarding the ravages of disease and the loss that is often incurred through the breeding of heifers which give disappointing milk yields, and (*b*) to the institution of a breeding scheme which aims at eliminating the home-bred poor milker and presents a marked contrast in many respects to the customary methods of estimating the value of dairy sires. Proof of the value of the Bull Rearing Scheme lies in the future, when the milk yields of daughters bred by each sire become known. Meanwhile preliminary data on the investigations that have so far been carried out are presented.

The Institute Herd and Herd X.

Institute Herd.

This herd of Dairy Shorthorn cows is maintained at the Hertfordshire Institute of Agriculture, where it is always on view and has provided a continuous supply of material for teaching purposes, demonstrations, etc. As an econonic unit it has never failed (except in one year) to be successful, and milk yields have exceeded the average for the County Milk Recording Society. The history of the herd from the point of view of disease control measures has already been outlined.

Herd X.

This is one of the best herds in the Eastern Counties, whether judged by honours won in herd competitions or by milk yields. The success of the management may be judged from the fact that, after the first year or two, every cow in the herd has been home-bred, and no animal has had to be discarded primarily on account of low milk yield.

Outline of Events.

During the past fourteen years 149 animals entered the Institute herd, 34 as purchased cows, 53 as purchased heifers, and 62 as home-bred heifers. The herd now consists of 5 animals that were originally purchased as cows, 4 that joined the herd as heifers from outside sources and 15 home-bred heifers.

Of the 125 animals drafted out of the herd, 42 per cent. were rejected because of failure to pass the tuberculin test, 32 per cent. because they were poor milkers, 11 per cent. on account of udder or calving troubles, 8 per cent. as barreners, 7 per cent. on account of Johne's disease, and the remaining 7 per cent. for a variety of reasons, including old age.

The average ages of the cows in the herd and of the drafts from it have not varied greatly from year to year. Twenty-nine purchased cows remained in the herd for an average of 2 years 4 months, 49 purchased heifers gave service in the herd for an average of 2 years 3 months, and 47 home-bred heifers for an average of only 1 year 4 months. The average herd life of the 125 drafts was 1 year 11 months and, if allowance is made for long-lived animals still in active service, the mean life of all the animals, as milk producers, did not exceed 2½ years. This compares unfavourably with an average herd life of 3½ years in Herd X, and is of course accounted for by the speedy rejection of reactors to the tuberculin test, and by the short life granted to poor milkers.

Table I shows the average age composition of both herds and of the drafts from each.

TABLE I.

Age in lactations.	Institute Herd.		Herd X.	
	Percentage in the herd.	Percentage in the drafts.	Percentage in the herd.	Percentage in the drafts.
1	32	32	29	20
2—3	35	37	37	39
4—5	20	15	18	18
6—7	9	11	9½	13
8 and over	4	5	6½	10
	in the herd	drafted out	in the herd	drafted out
Average numbers per annum (all ages)	32	9	50	11
Ratio	3½ to 1		4½ to 1	

In both herds cows of all ages have been represented each year, the proportion being approximately one-third first calvers, one-third second or third calvers and one-third older cows. From both herds drafts were made at all ages, second and third calvers providing proportionately the highest numbers. On the average the annual rate of wastage in Herd X was two cows out of every nine in the herd, while the corresponding figure in the Institute herd was two cows out of every seven. Further, 20 per cent. of the drafts from Herd X were first calvers compared with 32 per cent. from the Institute herd. In the former case the ratio of heifers drafted to heifers in the herd was 1—6½, giving a high survival to an older group, while in the latter case it was 1—3½, equivalent to the average wastage in this herd. Under these circumstances the Institute herd failed to be self-supporting, while Herd X succeeded in this respect—a very important distinction from the point of view of the successful application of disease-control measures.

While the shortness of the average milking life of the cows in both herds is apparent, the persistence of a few old cows, even to the tenth and twelfth calves, is indeed remarkable; and as time goes on it will be interesting to find whether protection from infection, as now practised in the Institute herd, will secure longevity equivalent to that resulting, in the case of a few cows in both herds, from natural immunity to infection.

Causes of Disposal.

Having described the general trend of events it is now proposed to deal with the main causes of disposal.

Tuberculin Test.—The general policy regarding the use that has been made of the tuberculin test has already been indicated. After eight years of rather desultory testing a vigorous policy of eradication was pursued. All cattle from the youngest to the oldest were tested, reactors were removed from the herd as quickly as possible and no animal was admitted to the herd without first having passed the test and having been subsequently isolated till a second negative test had been obtained. Throughout the whole period, in fact, except during the first year, purchases were made on a "subject to test" basis.

The results are concisely summarized in Table II.

In the first eight years reactors were spread fairly evenly over all ages, many of them having a history of one negative test followed by a positive. In the succeeding two periods young cows showed the greatest infection, more than one-third of the first calvers failing to pass the test. These results coincide with the high incidence of "wasters" in young cows in Herd X. A Grade A T.T. licence was acquired in February, 1932, and it was disappointing, after the drastic "clean up" of the previous two

TABLE II.

Relationship between Age (in lactations) and Reactions to Tuberculin Test.

Institute Herd.

Period and Number of Tests.	Actual No. of Reactors.	Reactors stated as percentage of total number in each age group.				All.
		1	2–3	4–5	6+	%
1922–30 (6 tests)	22	8	8	14	12	10
1930–32 (6 tests)	19	35	17	—	12	23
1932–34 (4 tests)	13	39	9	18	—	17
1934–36 (4 tests)	4	9	5	7	—	6
14 years	58	19	9	12	8	13

Relationship between Age (in lactations) and Collapse from Wasting Diseases.

Herd X.

20 years, "wasters" and "bad doers."	100	8	14	9	6	10

years, to find that infection still persisted under Grade A T.T. conditions. However, the last two years have been rather more reassuring, and hopes of reaching "Attested" standard were entertained and finally fulfilled in the subsequent year.

Poor Milkers.—Each source of herd replacements provided its quota of poor milkers, and in the following proportions: purchased cows 10 per cent., purchased heifers 45 per cent., home-bred heifers 45 per cent. On the other hand, many cows milked well, as is shown by the facts that 30 of them were registered as foundation cows in the D.S.A. Year Books and that six were awarded Certificates of Merit by the Ministry of Agriculture. It is probably true also that some young cows that would have done credit to the herd from the point of view of milk yields had to be rejected on failing to pass the tuberculin test; certainly only six animals gained the double distinction of failing to pass this test and being classified as poor milkers.

Special interest under this heading attaches to the breeding history of certificate-of-merit and "foundation" cows. Five foundation cows and a descendant of another (two of them still in the herd) were awarded Certificates of Merit by the Ministry of Agriculture. These cows have, between them, given 36 years 8 months of excellent service. They have bred 17 heifer calves, of which 15 should have reached the herd by this date. Actually

only 8 have done so, and of these only 3 gave sufficient milk to justify their retention.

Of the other 25 foundation cows, 6 are still in the herd but only 7 have descendants on the farm. Altogether these 25 cows bred 50 heifer calves, of which 24 have reached the herd. Eighteen of these have gone after a total of 25½ years' service, 5 of them because of failure to approach the performance of their dams.

Finally, the influence of the various bulls in the Institute herd calls for comment. The first three bulls to be used have all left their mark on the herd. They were selected as dairy sires, their dams being "qualified bull breeders," and each of them would assuredly have found a place in some dairy herd. Their progeny records are given below :—

		Calculated Average Mature Yield.	*Number of lactations.*	
		Gallons.	Total.	Average.
E.M.	8 Dams	828	(46)	6
	8 Daughters	613	(16)	2
S.V.	9 Dams	783	(37)	4
	9 Daughters	627	(19)	2
M.D.	4 Dams	827	(23)	8
	4 Daughters	555	(7)	2

From the above figures it will be noted that dams had milk yields averaging about 800 gallons and that they remained in the herd for an average of five lactations. The daughters gave 200 gallons less milk per lactation during a much shorter life; in one generation it might be said that the level of production had dropped back to the general average of dairy cows throughout the country. This tragedy was brought about by the use of high-priced bulls with milk-recorded ancestry.

Wastage—Two Herds Contrasted.

In Table III are given the relevant facts regarding causes of disposal and the relative incidence of the main groups of causes, together with average prices realized for drafts from the two herds.

The collapse of many cows through wasting diseases in one herd (45 per cent.) has a counterpart in the large number of reactors to the T.B. test, together with the few victims to Johne's disease (47 per cent.) in the other. Similarly, a wastage of 42 per cent. due to barren cows is balanced by 39 per cent. poor milkers and a few barreners. Finally, 87 per cent. for one set of causes, mainly "wasters" and barreners, corresponds with 86 per cent. for another set of causes, mainly reactors to T.B. test and poor milkers. The only significant difference is the low prices for wasters and bad doers compared with those for reactors. Many of the latter were sold as they stood, often in milk, for slaughter.

TABLE III.

Relative Incidence of Wastage.

Herd X. Cause.	No.	%	Typical Price. £ s. d.	*Institute Herd.* Cause.	No.	%	Average Price. £ s. d.
"Wasters"	81	45%	3 15 0	Johne's disease	7	47%	2 2 10
"Bad doers"	20		7 12 0	Tuberculin test	52		13 11 0
Fat	4	42%	22 10 0	Poor milk yield	40	39%	17 8 6
Not stated	36		20 0 0	—	—		—
Barren	54		13 7 0	Barren	8		17 6 3
Udder, Milk Fever, Calving	15	13%	4 12 0	Udder, Milk Fever, Calving	11	14%	8 14 6
Various troubles	7		5 4 0	Various troubles	6		6 16 8
Old Age	7		1 5 0	Old Age	1		3 0 0

Other causes of disposal are relatively few in both herds, so few, in fact, that (unlike abortion and T.B.) good management seems to be all that is necessary to keep most of them under control. This applies particularly to garget, milk fever and calving troubles. There remain a few drafts due to obscure causes, and one last cause of disposal which is a testimony to the vitality of a few cows—old age, unqualified by any particular indisposition. The spread of the drafts over various ages is summarized in Table IV, the final figures for all causes of disposal being compared with those in Herd X.

TABLE IV.

Age Incidence of Various Causes of Disposal.

	No.	Age in lactations. 1	2-3	4-5	6 +
Tuberculin Test	52	18 (35%)	16 (31%)	11 (21%)	7 (13%)
Poor Milkers	40	11 (27%)	24 (60%)	3 (7½%)	2 (5%)
Barren ...	8	3	2	3	—
Udder, Milk Fever Calving, etc.	11	4	1	1	5
Johne's Disease	7	2	3	—	2
Various	6	2	1	1	2
Old Age	1	—	—	—	1
Total	125	40	47	19	19
Percentage, Institute herd		32	37	15	16
Percentage, Herd X		20	39	18	23

As has already been noted, young cows are the main victims of tuberculosis, and of course those disqualified on milk yields

are rejected in early life. In Herd X 59 per cent. of the drafts are first to third calvers, a figure which rises to 69 per cent. in the Institute herd owing to the high incidence of tuberculin reaction among first calvers, the sale of young cows because of poor milk yields and the shorter life of the cows generally.

Life History of Calves.

The history of all calves in the Institute herd is summarized in Table V below :—

Table V.

Wastage and other History of Calves.

	Singles.				Twins.	
	Bull Calves.		Heifer Calves.		All.	
	No.	Per cent.	No.	Per cent.	No.	Per cent.
Aborted	17	10	15	10	8	21
Dead at birth	11	6	3	2	8	21
Died under 14 days	4	3	2	2	1	2½
Died over 14 days	1		1			
Sold as calves	72	43	11	7	15	40
Sold barren	—	—	2	1	—	—
Sold as baby beef	55	33	8	5	2	5
Sold on reacting to tuberculin test	—	—	25	17	1	2½
Sold for other reasons	8	5	6	4	—	—
Reached herd	—	—	77	52	3	8
Total	168	100	148[1]	100	38	100

[1] 148 is the correct total as two calves included under abortion were reared, one being sold as a calf and the other on reacting to the tuberculin test.

Losses through abortion amounted to 10 per cent. of all the single births, irrespective of the sex of the calf. Full time male calves were more frequently stillborn than full time female calves, the average for singles of both sexes being 4·4 per cent. Thereafter casualties were very few in number. Six out of 316 died under the age of fourteen days and only 2 later in life. Of the remaining bull calves, numbering 127, all but 8 were either sold as immature veal or were converted into baby beef (Ref. 4).

Seventy-two bull calves, and 11 heifer calves out of low yielding cows, were sold at slightly under one month of age.

The 6 heifers sold for other reasons include 2 "bad doers" and individual cases of white scour, rickets, Johne's disease and wooden tongue. In addition, 11 heifers were sold as calves and 8 as baby beef.

Two further heifers were lost through sterility, bringing the number down to 102 out of an original total of 148. But, as it

had been decided that every animal joining the herd must be free from tuberculosis, these animals, along with others, were subjected to test and 25 of them reacted before calving. This further loss reduced the number available to enter the herd to 77, to which must be added 2 from the twin births, making 79 in all. As 17 of these have not yet reached calving age, the position may be summarized by saying that, in eleven years, 60 out of the 123 single heifer calves, and 2 twins, actually reached the herd.

Twins were wasted bounty. Thirty-eight calves provided only 3 double heifers, or 6 likely breeders. Two of these were stillborn, 1 reacted to the T.B. test at 32 months of age, 2 were reared and calved in the herd, and 1 is still a calf. The other twins present an equally dismal picture: 8 were born prematurely, 8 were dead at birth, 1 died, 2 were converted into baby beef, and the others were sold as calves.

Thus in the Institute herd over a period of eleven years, with equality between the sexes of the calves and a gross wastage amounting to 50 per cent., *approximately 4 calves were required to produce 1 cow in milk; and, as the cow wastage was at the rate of 1 to 3½, it is apparent that this herd was not self-supporting. The comparable figures in Herd X were approximately 3½ calves to produce 1 cow in milk, but, with a herd wastage in the neighbourhood of 1 to 4½, this herd was not only self-supporting but capable of an increase in size.*

One other point calls for mention. Since a large proportion of heifer calves and young stock were sold at relatively low prices, the cost of rearing the remainder was necessarily high. At the Institute farm this cost some years ago was not less than £30 per head, and it still exceeds £25. The conclusion is therefore reached that it is not worth while rearing stock in the Eastern Counties, where the costs are necessarily high in any case, unless the circumstances permit of effective control of either disease or breeding results—or preferably, of course, of both.

Abortion and Dead at Birth.

The data already discussed under these headings are summarized in Table VI.

TABLE VI.

Incidence of Abortion in Two Herds.

	Singles.		Twins.	
	Herd X.	Institute Herd.	Herd X.	Institute Herd.
Percentage aborted .	7·1	10·1	15·4	21·1
Percentage dead at birth	5·1	4·4	23·1	21·1
Total . .	12·2	14·5	38·5	42·2

That such results are typical is confirmed by records of the incidence of abortion on 177 milk-recorded farms during one year. In this survey it was noted that abortion occurred on 37 per cent. of the self-contained herds and on 52 per cent. of the others. Taking the herds, 83 in number, on which abortion occurred in the year of the enquiry, 8·2 per cent. of the calvings were premature in 22 self-contained herds and 11·6 per cent. in the remaining 61, which were not self contained.

In many herds it is a common practice to run heifers and cows together in the expectation that the heifers will meet the infection with contagious abortion early in life and thus acquire immunity. If there is any scientific basis to support this custom it is scarcely vindicated by the following data, which show how variable is the incidence and lactation sequence of abortion in individual animals. In the Table the symbol 0 is used for a normal calving, 1 for an abortion, and a dash (—) for previous calvings in other herds.

TABLE VII.

Number of Abortions.

1			2	3	4
1	--1	01	11	0111	0101101
1	--1	0001	011	011001	
1	--01	00100		0000111	
10	--01	00100			
100	----10	01000			
1000	--00001	--0001000			
		----0000001			

25 cows — 36 abortions.

In triennial periods (calendar years) abortion occurred as follows :—

1922–24, 3 ; 1925–27, 14 ; 1928–30, 12 ; 1931–33, 4 ; 1934–36, 3.

Blood agglutination testing started in September, 1933, and has since been carried out quarterly. At the first test seven cows gave a positive reaction and these (unless sold for other reasons) along with any subsequent reactors, have been retained in the herd. They are grazed in a separate field, summer and winter, but twice daily enter the same cowshed as the clean herd, to be milked. As this system of segregation, in association with precautions in cowshed routine, is being investigated by the Royal Veterinary College, it is only necessary to say that the results as indicated by the above results are promising, if not conclusive, and that a source of continual anxiety has been largely removed.

Age Incidence of Reaction to the Tuberculin Test (Home-Bred Heifers).

In the four tests carried out between September, 1930, and October, 1931, inclusive, 14 young heifers reacted at the average age of 2 years 6 months after an average of two previous negative tests.

In the half-yearly tests of young stock since January, 1932, 11 animals reacted at the average age of just under $2\frac{1}{2}$ years, after an average of $4\frac{1}{2}$ successive negative tests.

Previously (page 109) it was noted that first-calf heifers appeared to be particularly sensitive to the test, and the above data suggest a similar sensitiveness in the case of in-calf heifers. Whatever the explanation, it is apparent that the main incidence of reactions in this herd has been among in-calf and first-calf heifers.

BREEDING POLICY.

Having discussed and illustrated with examples the havoc which can be occasioned in a dairy herd by disease, it is now appropriate to discuss another problem of equal importance. The short life of the cow is due mainly to two causes—disease and low milk yields. Survey investigations into the causes of disposal of cows (Ref. 2), have shown that, with the exception of sterility, more cows are removed from herds on account of low milk yields than for any other reason. While udder troubles or ill-health may contribute to some extent to this result, there is no doubt that the main cause is the inheritance of poor milking capacity. The progeny record of bulls used in the Institute herd (page 111) and in many other herds (Ref. 3) have shown how seriously an individual sire can lower the yield of milk from home-bred stock. When such animals give uneconomic milk yields their lives are likely to be extremely short unless, indeed, they are passed from one milk producer to another, leaving a trail of disappointment. Moreover, if they form the majority of the progeny of the one sire in a herd, they may spell ruin to the owner. Assuredly, the eradication of disease from dairy herds is a most desirable aim, but the benefits may not fulfil expectations unless health is combined with productivity. The two issues, freedom from disease and satisfactory milk yields, are complementary. A healthy heifer calf reared till she finds a place in a disease-free herd, will have a short lease of life unless she gives an adequate amount of milk, and every step taken towards eliminating losses by disease strengthens the need for a breeding policy which will take full advantage of the improved conditions.

Now the results in breeding for milk in the Institute herd raised an acute problem that had either to be faced or shirked. It was felt that little credit would result from the adoption of

the latter alternative, whether by change of breed or otherwise; hence the adoption of the bull-rearing scheme which has been briefly described. Encouraged by various breeders and authorities, bull calves were reared, a catalogue on original lines was prepared, and the first annual sale of young bulls bred from progeny-recorded stock was held at the Institute in the autumn of 1933. At the start many mistakes were made; both the quality of the bulls and their condition on the day of the sale left much to be desired, but the response on the whole was good. At each subsequent sale the method of setting out milk pedigrees was improved, experience led to better management of the stock, prices rose, and data have been accumulated on rate of growth, food consumption, and the cost of rearing the bulls and preparing them for sale. But the main point for the moment is the change which has been effected in the manner of presentation of the milk pedigrees. In order to measure the improvement, a standard for comparison was necessary and for this purpose the milk pedigrees of 99 bulls sold at the sale of the Dairy Shorthorn Association at Birmingham in 1933 were analyzed (Fig. 1). The information thus collected was subsequently confirmed and amplified by making a more complete analysis of the bull pedigrees in the 1933 catalogue, and by extending the data to include the milk pedigrees of 150 bulls sold at the Birmingham sale in 1935. The combined data for these two sales is summarized in Fig. 2, while Fig. 3 shows the comparable information from the milk pedigrees of 41 bulls sold at the first three sales at the Institute. A few explanatory notes on the diagrams are given below:—

Fig. 1. This figure gives a quantitative representation of milk pedigrees as they are commonly presented in sale catalogues, and shows how far milk records are associated with each of the female ancestors, irrespective of the amount of milk given. Register of Merit Certificates (R.O.M.) provide the only equivalent data for sires. Fig. 1 is therefore the average milk pedigree of 99 dairy bulls, and this condensed summary is discussed below:—

1st generation. All the dams had milk records but only 4 per cent. of the sires possessed the partial progeny record of the Register of Merit.

2nd generation. The paternal grand-dams were all recorded cows but only 78 per cent. of the maternal grand-dams were credited with milk records. The grand-sires included 17 per cent. and 15 per cent. respectively of Register of Merit bulls.

3rd generation. A high proportion (90 per cent. or more) of the great-grand-dams, namely the sire's sire's dam and the dam's sire's dam were recorded, but less attention (61 per cent.)

was given to dam's dam's dam, and still less to sire's sire's dam (30 per cent.). The four great-grand-sires held Register of Merit certificates to an extent varying from 5 per cent. to 16 per cent.

4th generation. In this generation milk records of the dams of the two maternal great-grand-sires were given in respect of 72 per cent. and 66 per cent. respectively, while dams of the two maternal great-grand-dams were relatively neglected (7 per cent.

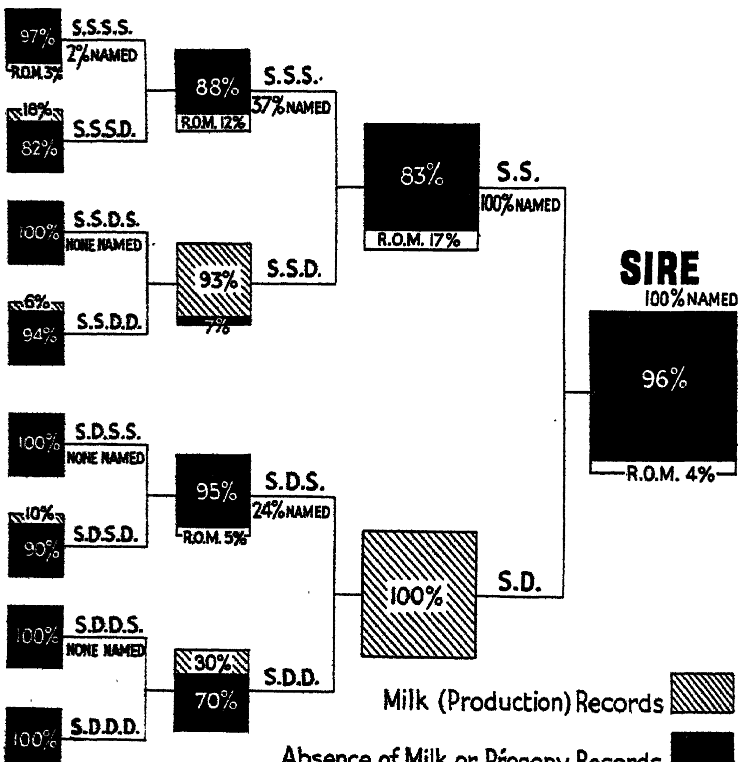


FIG. 1.—Average Milk Pedigree of 99 Bulls sold at the sale of

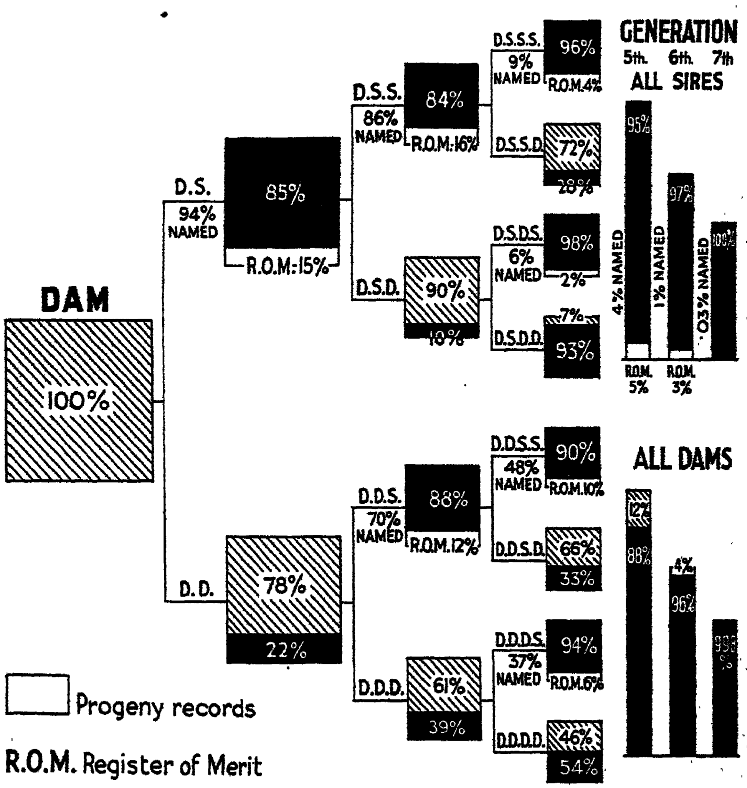
and 46 per cent.). The presence in this generation of a few Register of Merit bulls (2 per cent. and 10 per cent.) was noted.

On the sire's side information practically ceased in the third generation. Three of the paternal great-great-grand-dams had records attached to their names (18 per cent., 6 per cent. and 10 per cent.), and Register of Merit sires were mentioned only

in connection with one great-great-grand-sire in the male line (3 per cent.).

Distant Ancestry.

While the third generation practically completed the milk pedigree on the sires' side, Register of Merit bulls continued to appear on the dams' side up to the sixth generation. On the other



the Dairy Shorthorn Association, Birmingham, 1932.

hand, the ancestry of dams was embellished with the milk records of individual animals up to the seventh and even to the tenth generation. This inequality in the treatment of the two main branches of the pedigree is doubtless due to a system which requires all the particulars of a sire's ancestry to be included in one paragraph, while giving extended latitude for tabulating

an unlimited number of records of certain maternal g . . . dams.

The lack of balance in Fig. 1 is the result of systematic inconsistency ; yet it is obvious that great care is taken to make the data as accurate as the system will allow.

Fig. 2. In the preparation of this diagram a qualitative examination of the milk records of dams and grand-dams of

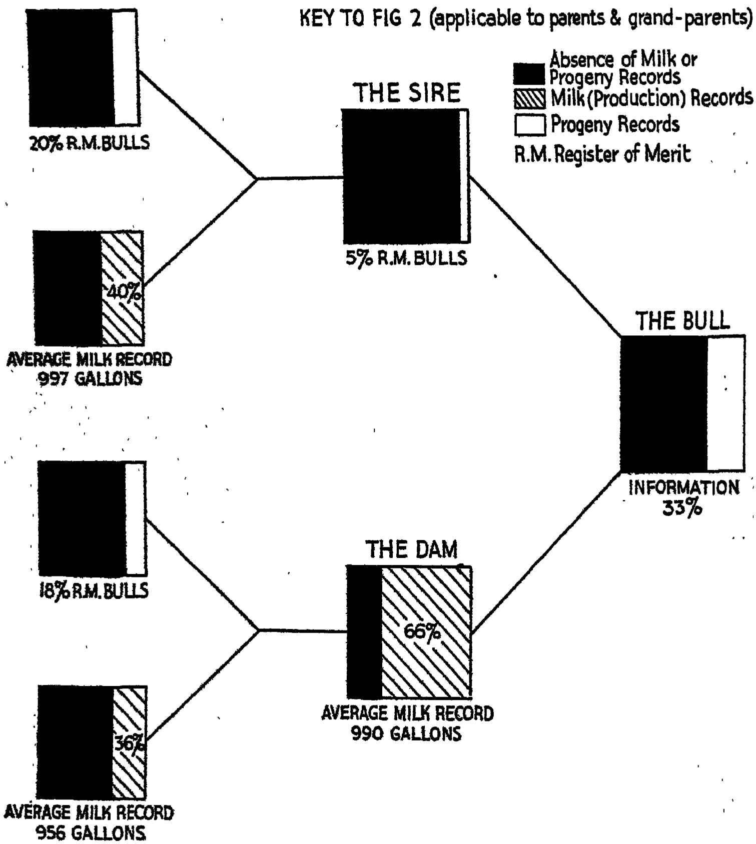


FIG. 2. Average Milk Pedigree of 249 Dairy Shorthorn Bulls, Birmingham, 1933 and 1935.

249 bulls sold at Birmingham in the years 1933 and 1935 was made, and the proportion of Register of Merit bulls in the first two generations was also noted. Milk records were divided into three categories :—

(*a*) Those in which the records were accurately stated for each calf and for lactations not exceeding 315 days.

(*b*) Those in which the records were not so accurately stated as in (*a*) but were nevertheless capable of reasonable interpretation.

(*c*) Those in which the records were entirely misleading or incapable of reasonably accurate interpretation. Frequently the lactation concerned was not specified or yields were given

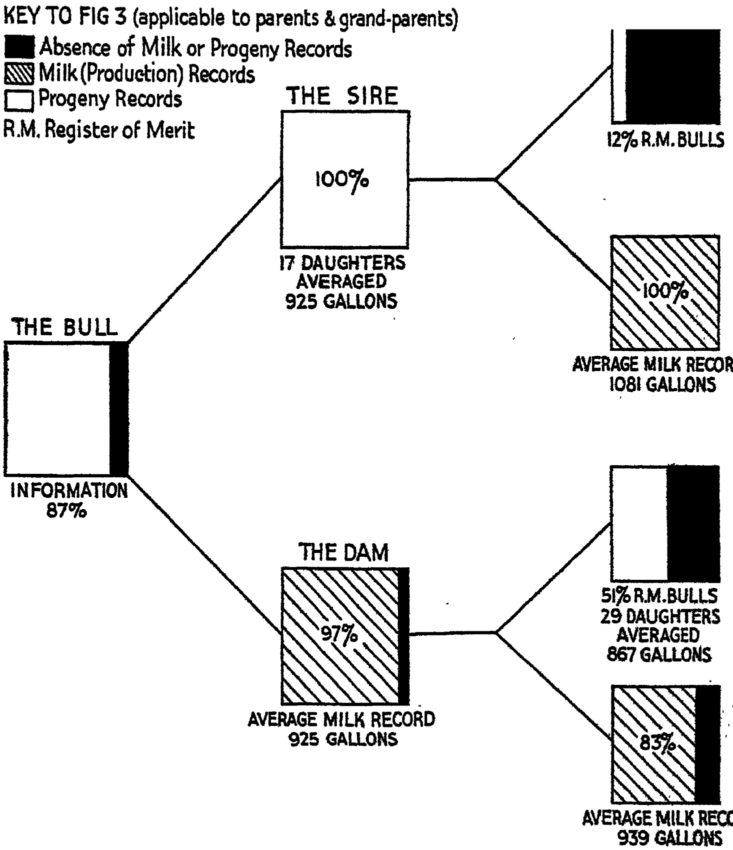


Fig. 3.—Average Milk Pedigree of 41 Dairy Shorthorn Bulls, Oaklands, 1933, 1934 and 1935.

for one or more recording years and not in lactations. In other cases the length of the lactation was excessive or its length was not stated (often it was obviously very long). Such misrepresentations occurred singly and in every possible combination.

It is obvious that only the first two groups provide information that is of any comparative value, and all of these records

were converted into average mature yields so that they could be averaged for individuals and groups of individuals. Fig. 2 is therefore the average milk pedigree of 249 bulls; discussion follows in the next paragraph.

Fig. 3 and Comparison of Figs. 2 and 3.

Fig. 3 has been prepared to show the quality of the milk records and progeny records of the parents and grand parents of the bulls sold in the first three sales at the Institute. It represents the average milk pedigree of 41 bulls, the procedure in condensing the data into one diagram being exactly the same as that adopted in the preparation of Fig. 2. The contrast between the two diagrams (Figs. 2 and 3) may be summarized as follows:—

Dams. In the Birmingham sales very nearly all the dams possessed milk records, but only 66 per cent. of them were accurately or reasonably accurately stated; whereas in the Institute catalogues all available records (97 per cent.), good and bad, were fully and correctly given. Special attention is drawn to the satisfactory yield of the dams of the Birmingham bulls. A mature yield of 990 gallons from such a representative sample is highly complimentary to the milking qualities of the Dairy Shorthorn. The slightly lower average of the dams of the Institute bulls (925 gallons) is sufficiently high to provide further confirmation of the high qualities of the breed concerned.

Sires. The black or uninformative picture of the milk transmitting capabilities of the sires of the Birmingham bulls is in marked contrast to the illuminating progeny records in Fig. 3. Five per cent. of Register of Merit bulls is a very poor guide to intending purchasers compared with 100 per cent. progeny records indicating the transmission of milk yields at an average of 925 gallons per daughter.

Grand-dams. In the Birmingham catalogue only 40 per cent. and 36 per cent. of the grand-dams had interpretable milk records, compared with 100 per cent. and 83 per cent. in the Institute catalogues. The average quality of these records leaves little to be desired in either case.

Grand-sires. Register of Merit bulls figured in both sales, 20 per cent. and 18 per cent. at Birmingham, and 12 per cent. and 17 per cent. at the Institute, but the milk pedigrees of animals in the Institute sales were supported by progeny records for just over half the maternal grand-sires as well as by the 17 per cent. of Register of Merit bulls mentioned above.

A concluding comparison between the two systems is afforded by assuming that 50 per cent. of the required information regarding milk inheritance is obtained from parents and 25 per cent. from grand-parents, and calculating the percentage of the possible 75 per cent. from these two generations that has actually

been presented. On this basis it is found that catalogues which are far in advance of many others in their comprehensiveness and accuracy, provide on the average no more than 33 per cent. of the really essential data compared with 87 per cent. in the experimental system. To purchase a bull on the former basis cannot be other than a gamble. Further, by dividing the Birmingham bulls into three groups, those realizing the highest, intermediate and the lowest prices, and comparing the milk pedigrees of each group, it was found that milk records of dams and grand-dams had surprisingly little influence on realized values. Thus, while the dams of bulls in the highest-priced group had slightly better records than those in the other two groups, the cheapest group of bulls were out of dams with rather better milk records, on the average, than those in the intermediate group. It is apparent, therefore, that most farmers select their future herd sires with but little reference to such milk pedigrees as are presented. On the other hand, prices realized at the Institute sale, where milk pedigrees include both progeny and milk records, indicate a real appreciation of the value of milk records when they are fully and fairly used in setting out milk pedigrees.

General Discussion.

The problems discussed in this article are a source of serious and continuous difficulty to individual milk producers; losses must amount to millions of pounds per annum. The data on which the article is based have been drawn mainly from two well-managed herds on which records of events have been kept for many years. By the analysis of these records it has been possible to focus attention on the chief disturbing factors in both herds. This method presents a sharp contrast to the surveys of the wastage in dairy herds that were conducted a few years ago in the Cambridge and Reading provinces. Unfortunately the information collected in these surveys has not been brought together in one publication to which reference can be made. Broadly speaking, however, they provide conclusive proof that, in the areas surveyed, the main causes of wastage in dairy herds are wasting diseases (tuberculosis and Johne's disease), sterility and poor milking capacity.

In the two herds under review intimate contact with the herd records has brought out a substantial amount of new information as well as much detail that could not have been obtained in any other way.

In themselves the two herds present some interesting contrasts. Breeding for milk was successful in one and not in the other; as the result of experience gained, specific measures for the control of disease were introduced in one and not in the other. During the discussion of the data the extent to which

these problems are inter-connected has been stressed. Thus, without control of disease, efforts to benefit from milk recording and the use of specially selected sires may be largely wasted. So also lack of success in the breeding of deep-milking heifers tends to swell the wastage, as the replacement of "poor milkers" from outside infected sources invariably brings fresh infection and keeps up the rate of wastage. Most milk producers are drawn into this vicious circle, a fact that has been recognized in the recommendations of the Committee on Cattle Diseases (Economic Advisory Council). The tuberculin test, the blood agglutination test for abortion and tests for mastitis are the main contributions of the veterinarian towards the control of bovine diseases, but a quite infinitesimal part of the industry takes advantage of them. Those who peruse this account of the extent of the problems, and visualize the risks that the pioneer must run in applying remedial measures, will not blame the farmer for being cautious or conservative.

Contributions have been made in various ways towards the solution of the problems connected with the uncertainties in breeding for milk. The extent of the loss in milk yields that a farmer may suffer through the use of a herd sire, good in all respects except that he fails to put milk into his heifers, is noted from actual examples. Evidence has been given of the misleading manner in which milk records are often used in milk pedigrees, and of the almost total disregard of progeny recording in these pedigrees. As a result of such errors and omissions it is pointed out that the usual milk pedigree often fails to fulfil its purpose. A visual inspection of a young bull and of his dam may perhaps be little less reliable, as a guide to milk-transmitting ability, than many of the milk pedigrees that are printed.

A practical demonstration of a breeding policy, in which progeny records and milk records are equally stressed, has been described. This demonstration is regarded as a modern application of principles of long standing and recognized soundness. That such methods are not in general use has been shown by the detailed examination of the milk pedigrees of a large number of bulls sold at one of the most reputable annual sales in the country. Finally, the opinion is expressed that unless milk records cease to be used in an uncontrolled manner that is both inadequate and misleading, a golden opportunity to enter an era of progress in the breeding of dairy stock will be lost. The main issues are the elimination of a major source of loss in dairy herds due to the breeding of animals of low productivity, the exploitation of current efforts to eradicate disease by taking steps to breed animals of high productivity, and lastly, the stimulation of endeavours to equal, if not to lead, other countries

in the scientific application of milk recording to the art of stock breeding.

SUMMARY.

The sequence of events in a herd of dairy shorthorn cows, in which measures for the eradication of disease were gradually introduced, is described and is compared with that in another herd, an account of which has recently been published; the reasons for, and the principles underlying, a new breeding policy are discussed.

Results from the shorthorn herd are summarized below, comparable figures from the "other herd" being shown in brackets.

Calves and Young Stock.

1. Heifer calves, up till the time of joining the milking herd, suffered a wastage, mainly from disease, of 50 per cent. (33 per cent.); thus, with equality between the sexes, approximately 4 calves (3½) were required to produce 1 cow in milk.

2. 14·5 per cent. (12·2 per cent.) of the single births and 42·2 per cent. (38·5 per cent.) of the twin births were still-born. Of 335 (940) births 10·7 per cent. (7·7 per cent.) were abortions.

3. Measures taken to prevent the spread of abortion from infected animals have given promising results.

4. The age incidence of reactions to the tuberculin test is noted.

Cows.

5. On the average 1 in 3½ (4½) was drafted out of the herd each year, but, as the result of disease control, this ratio became 1 in 5 during the past two years.

6. Tuberculin testing resulted in a high incidence of reactors in cows with their first calf, and this is contrasted with the high incidence of "wasters" in young cows in the other herd.

7. The two factors mainly responsible for the short life of the cows—2½ years (3½)—were reactions to the tuberculin test and the poor milking qualities of home-bred heifers; the interaction of these problems is discussed.

Breeding.

8. A bull-rearing scheme, based on the selection and rearing of bull calves bred from progeny-recorded sires, and out of selected dams, is described.

9. Arising from the above scheme analyses have been made of milk pedigrees of young dairy bulls in recent sale catalogues. It has been shown that, on the average, the milk pedigrees of

these bulls gave only 33 per cent. of the possible information regarding the milk-transmitting qualities of sires and grand-sires and the milk production of dams and grand-dams. This percentage compares with 87 per cent. in the bull-rearing scheme.

J. Hunter Smith.

Hertfordshire Institute of Agriculture.

References.

1. Hunter Smith, J. "Changes and events in a large dairy herd from 1912 to 1932." *Empire Journal of Experimental Agriculture,* Vol. **11**, No. 6, April, 1934.
2. Annual Reports of certain Milk Recording Societies.
3. Edwards, J., and Hunter Smith, J. "The Importance of the Progeny Test in Dairy Cattle Breeding." *Journal of the Royal Agricultural Society of England,* Vol. **93**, 1932.
4. Hunter Smith, J., and Gardner, H. W. "Super-English or Baby Beef." *Journal of the Ministry of Agriculture,* Vol. **35**, No. 8.

NOTABLE FARMING ENTERPRISES.—VIII.

The Leckford Estate Limited.

The Leckford Estate Limited was formed as a private company by Mr. J. Spedan Lewis to undertake the management of the whole of the estate, amounting to approximately 3,800 acres, which he purchased in 1929. The whole area has been in hand since 1932.

In addition to Mr. Lewis there are five other directors, of whom three will be particularly well known in agricultural circles as having contributed materially towards the advancement of farming—Sir Algernon Peyton, the Oxfordshire land-owner; Mr. R. Dudley, one of the pioneers of the so-called mechanized corn growing system in England; and Mr. W. D. Hollis (the Managing Director), who has had a long record of successful light-land farm management both in Norfolk and Hampshire; the two latter have read papers before well-known societies and at public meetings in which their practical conclusions have been summarized.

The Leckford Estate Company started operations under singularly favourable general conditions in that its personnel combined some of the most able and successful "big business" men with others who were widely experienced not only in practical farming, but in farming on a large scale. Finally, of course, the Company had command of ample capital and was in a position to develop whatever form of activity might be considered worth while, without the need to look for the immediate cash return, which need so often dictates farming policy.

One of the most interesting general conceptions which has been kept to the fore in framing policy has been the desirability of maintaining a thoroughly happy, healthy and interested country community on the estate. From the outset all workers and their families have been made to realize that they have a definite stake in local affairs, and that their well-being is a matter of primary concern. Apart from the improvement of farm cottages and the building of a central hall, estate water and electric light supplies have been developed and now extend throughout the area; a central bath house has been erected, two cricket grounds are maintained—one situated in each of the villages concerned—and a first-rate nine-hole golf course has been laid out and is maintained in a condition second to none. The workers on the estate are encouraged to make full use of these recreational facilities. Another successful activity is the annual flower show organized for those on the estate. The connecting link between all these activities is probably unique, taking the form of a Weekly Estate Gazette which not only summarizes

local news of interest but gives its readers a really sound insight into the business aspects of farming operations and other estate activities ; this should prove invaluable in developing a sense of personal responsibility in all those on the place.

In view of the increasingly rapid drift of rural workers to the towns in recent years, and the acute difficulty that obtains, even now, in finding a sufficient supply of trained agricultural labour, the consideration that has been given at Leckford to the development of amenities for rural workers would seem likely to be worth while from a material standpoint alone. It is the opinion of many competent men that the lack of amenities in the country, in contrast to the town, is of even greater importance than the difference between agricultural and urban wage rates.

The administration of estate business is another matter of general interest, and in this the influence of "big business" organization is clearly apparent. There is a Secretary-Accountant, responsible for the central office, and the various activities of the estate are split into Departments, each of which has its own Departmental Manager. In addition to the normal production enterprises which form the main subject of this article, mention may be made of the Fishing Department, which is responsible for over six miles of some of the best of the famous Test trout fishing ; the Grounds Department, which is responsible for the playing fields, golf course, etc. ; and, on the production side itself, a Fruit Farm which is organized as a separate entity. In each case the Departmental Manager has to prepare a detailed budget of estimated expenditure and returns which, before being incorporated in the general annual estimates, is given full consideration and is subjected to a thorough comparison with the actual results of the previous year. In due course the actual figures of expenditure and revenue are closely examined in relation to the estimates, in order that greater accuracy may be obtained from year to year, and close control of the financial side, and of policy, retained by the Directors.

Transfers of home-produced articles, such as feeding-stuffs, from one department to another are accurately accounted for, and the price is agreed to the mutual satisfaction of the respective managers before the transaction takes place.

Costings are prepared for each field and for each enterprise, necessitating the use of daily time sheets for all employees. In addition, detailed store and disposal records are kept for all commodities. Finally, full weather records are kept at a meteorological station.

The estate itself is compact and is almost equally divided by the valley of the river Test, running roughly north and south. There is approximately 1,400 acres of effective agricultural land

at Leckford on the east, and 1,300 acres at Longstock on the west. The river valley itself, though half-a-mile in width, is of little farming importance, but the roads on each side form the principal means of communication. The land rises, steeply in some places, from a height of about 150 feet above sea level to a maximum of 400 feet at the top of the downs. Geologically, the whole of the land overlies the Upper Chalk and is typical of this formation as it occurs in the South of England. In the valley there are certain local gravel terraces, while on the flat tops of the hills are found deposits of clay-with-flints which may vary in depth from 1 to 20 feet. The soil above the clay is reddish in colour and contains a very high proportion of fine silt. It is consequently sticky in texture, is difficult to reduce to a fine tilth in a wet season, readily "runs" together if worked while wet, and rapidly becomes "nobbly" in a drying wind. Chemically, it is neutral or slightly acid, and it generally responds to dressings of both phosphates and potash. On the slopes also there is a certain amount of admixture of clay by downwash to lower levels, but, leaving this aside, the remainder of the land is a typical straight chalk, light in texture with a large number of flints and varying in depth from 4 inches on the downs to 18 inches at lower levels. This soil type is usually amply supplied with lime and phosphate, but is notably deficient in potash.

FRUIT.

Dealing first of all with the Fruit Department, the healthy, strong-growing appearance of the apple trees and the heavy crops of clean fruit are very striking, and indicate once again the inherent capacity of soil overlying the chalk, provided that cultivation is thorough and that the supplies of potash and humus are maintained.

The estate fruit farm started in the winter of 1929–30 with a 10-acre plot, mainly experimental, which was planted with a great number of varieties of apples, plums and pears, and interplanted with soft fruits. Next season a further 9 acres were planted with plums, apples, strawberries and loganberries, and in the course of the following year or two, acting on experience gained with the first plantings, a further 15 acres of bush apples were planted 18 feet square, so as to permit power cultivation. To these were added, in due course, 25 acres of plums and 10 acres of blackberries.

Thus the present fruit farm consists of some 68 acres of soft and top fruits, planted over a period of five years. Experience has shown that, of the various fruits planted, dessert apples are most likely to prove a real and lasting success; thus at the present time extensive reorganization is being undertaken in the earlier plantations with the view of eventually clearing out all

soft fruits except blackberries and loganberries, of reducing the apple varieties to one good cooking variety and one or two high-class dessert apples, and of so spacing the trees that the whole unit can be power cultivated and sprayed with ease. Regrafting and the moving of bush trees from the older orchard to new land will achieve this end.

Cultivation is carried out by means of a 15-h.p. caterpillar tractor. The orchards are ploughed during the winter and are cultivated during the summer either with discs or spring-tined cultivators as conditions call for. Spraying is carried out by means of a 4-h.p. mobile sprayer, and the spring spray schedule is usually supplemented later in the season with either sulphur or copper-lime dust as the variety and the degree of scab infection demand. Up to the present time there has been very little trouble from insect pests, probably because there is little other fruit grown in the district. However, both nicotine and lead arsenate are incorporated, as preventive measures, in the post-blossom lime-sulphur sprays.

Loganberries and blackberries are sprayed in the spring with lime sulphur against cane spot, and a derris dust is applied during the blossoming period.

Tree fruits are found to need annual supplies of potash, with plenty of cultivations and supplies of nitrogen to promote growth. The soft fruits need somewhat liberal supplies of nitrogen. Green manuring is being resorted to to supply the land with the necessary humus.

Apples are National Marked and are sold either on the fruit market or to private customers direct. Loganberries and blackberries are usually sold, under contract, to be canned or used for fruit syrups. Other soft fruits find a ready sale on the open market.

In the past, as with all young orchards, crops have been small. They are, however, increasing year by year, and in the course of the next few years, when the younger orchards commence bearing in real earnest, it is expected that there will be considerable crops to dispose of. The need for cold-storage equipment, in order to spread the marketing of the fruit over longer periods of the year, will probably arise in the near future.

The local supply of casual labour for fruit picking is supplemented by the provision of a camp of huts for sleeping accommodation and a large central messing hut ; in these a succession of harvesting parties of both young men and women, who normally work in one or other of the big London shops in which Mr. Lewis is interested, are encouraged to spend a portion of their summer holidays. The arrangement works excellently, and is deservedly popular with the campers. It enables them, practically free of cost to themselves, to spend a thoroughly happy and healthy

holiday in the country, and at the same time to perform what is undoubtedly a thoroughly useful piece of work.

GENERAL FARMING.

Speaking of the farm as a whole, the primary requirement in the maintenance of fertility lies in the maintenance of the organic matter content at a reasonable level, and this necessitates frequent additions of humus. Leckford is characteristic of the very extensive chalk belt in the southern half of England; on this fair corn crops were grown over a long period of years as a result of sheep folding and the ploughing in of green crops, but a large proportion of the land has steadily declined in fertility during the past thirty years and much of it is at present derelict. The apparent lack of any reasonably remunerative form of live stock husbandry to take the place of the expensive and often unremunerative close-folding system of sheep farming, and the undoubted lack of available working capital, are probably the principal factors which have brought about this result. For this reason a study of the farming developments at Leckford is not only of interest in itself, as showing how improvements can be rapidly effected, but the conclusions which may be drawn, even at this stage, have an additional value on account of their possible application over a wide area.

Much of the land at the outset was in poor condition, particularly the higher land situated at a greater distance from the homesteads.

In framing the farming policy the primary consideration has been that each farming enterprise must in itself offer a reasonable prospect of an adequate financial return; and unless, in due course, it has proved itself capable of this, it has been modified or scrapped. A consideration of the possibilities led to the following general conclusions:—

1. That on the free-working land, which was divided into large enclosures of convenient shape, arable farming should form the primary enterprise, and that here full use should be made of power implements in order to reduce the costs of production.

2. That the existing buildings and adjacent land could be economically utilized and improved to accommodate two commercial dairy herds which would serve to bring in a regular cash income.

3. That, in order to absorb labour which would otherwise be surplus through the adoption of mechanization, a fruit growing unit should be established.

4. That a close-folded sheep flock of sufficient size to maintain the fertility of the large arable acreage would prove uneconomic; and that, therefore, fertility should be built up and

maintained, firstly, by the ploughing up of the poorest worn-out grass and by sowing down modern mixtures of clover and grasses to last from three to five years. Secondly, the grass should be utilized for grass sheep and to maintain both pig and poultry units, and subsequently the remainder of the land should be brought in rotation into leys. Thirdly, a certain acreage of both roots and broadcast catch crops should be grown in order to supplement the sheep keep available from the temporary grass, and also to benefit the land.

5. Finally, that other live stock enterprises should be tried out experimentally.

Live Stock.

A herd of pedigree Large Black pigs was built up and was successful in winning the breed Herd Competition ; but owing to the increasingly high cost of feeding-stuffs during the past year in relation to the prices obtained for either breeding pigs or bacon, it was not considered that the possible return made it financially worth while to continue this enterprise. It was also felt that continuance of the herd must certainly involve extensive replacement of the plant left by the previous owners of the estate, and that the present prospect of profit from pigs would not justify such a venture. At the present time there are no pigs on the estate.

A large poultry unit was also developed, but has since been discontinued because it failed to yield sufficient returns.

Two dairy herds of commercial cows are kept, and each is being built up, by home breeding, to a capacity of 40 cows in milk. Licences for the production of "Accredited Milk" are held for both herds. With the exception of a few Guernseys, the majority of the cows are Dairy Shorthorns of a really sound dual purpose type, and these are being graded up for entry in the Herd Book. Milking is carried out twice daily by hand, and the success of the first herd from a yield standpoint may be judged by the fact that the average of full-time cows, during the last completed year of official milk records, reached the high figure of 935 gallons. "Leckford Louise," a home-bred Dairy Shorthorn Association Class C heifer, put up in the same year the highest record of all the heifers recorded under the Hampshire Milk Recording Society. It is obvious from an inspection of the herds that considerable care and attention have been given to the selection of type, and both the young stock and heifers now coming into the herd give promise of becoming really first-rate animals. Not a little of the progress may be attributed to the continued use of an outstanding bull, "Anderson Wild Bates," which, even at his present age of twelve years, is most impressive. His dam, "Yeldersley Wild Eyes 2nd," gave an average of 1,000 gallons

for ten calves, and his grand-dam, "Damory Kirklevington 5th," gave a 1,300 gallon average with 17 calves. The sire of this bull is the well-remembered Royal Show Champion, "Anderson Champion Bates."

Another form of cattle enterprise which has been attempted on a small scale during the past two years, and which has given encouraging results, is the production of prime young beef at an age of 18 to 21 months. A pedigree Aberdeen Angus bull is kept and is mated with those of the Dairy Shorthorn cows in the Leckford herd which are least promising from the point of view of breeding dairy heifers. The calves produced in this way are removed from their mothers when four days old, are reared on the bucket with whole milk (of which they receive about 60 gallons up till the age of three months), and are then brought on to dry feed entirely. They are encouraged to eat, as soon as they will, a mixture of concentrates consisting of linseed cake 40 per cent., crushed oats 30 per cent., middlings 20 per cent., fish meal 10 per cent., and are given hay as soon as they will pick at it. At six months of age the calves are drafted into yards and are kept in fresh condition and growing steadily until the final fattening period of five to six months, when the quantity of concentrated food is increased to a maximum of 6 lb. per day. The live weight of the animals when fit for the butcher has varied from 8½ to 10½ cwt., and both the quality and the capacity for live-weight gain of these first-cross animals have been of a high order.

Sheep.

Sheep, however, form the principal live stock enterprise, and the size of the flocks is being steadily increased by home breeding. The policy pursued remains somewhat elastic, but two entirely distinct flocks are kept, and may conveniently be described briefly under two separate headings.

At the present time there is a flock of from 500 to 600 Half-bred ewes, produced in the usual manner by crossing Border-Leicester rams with Cheviot ewes. This flock is being maintained and developed by the mating of 150 ewes annually with Border Leicester rams. The Half-bred ewes are crossed with either Dorset Down or Hampshire Down rams. Great care is taken in the selection of a fine-boned type of ram with high quality wool, which combines constitution with a compact, highly developed body and hind quarters.

Lambing takes place at the end of March on the large dry upland enclosures which have been seeded down to clover and grass-seed mixtures. A lambing pen of a simple type is erected to deal with difficult cases. Preparation of the ewes is effected by the feeding of concentrated food for six weeks before lambing.

Crushed oats, with the addition of a complete mineral mixture, are used, starting with ½ lb. and increasing to a maximum of 1 lb. per day. The quantity of hay required to supplement the winter grazing necessarily varies seasonally, but on an average hay will be used for a period of four to five months from December to April. The amount of trough food given to the ewes is decreased with the flush of grass, and the lambs are started feeding in creeps when about a month old. In the event of a scarcity of keep in early spring, and if surplus root crops are available, the whole flock may be hurdled and folded for a short time; but this is not the normal practice.

Weaning takes place in July, the ewes being removed to poor downland pasture. The white-faced ewe lambs to be retained for breeding are drafted to aftermaths and kept in fresh growing condition and the remainder of the lambs are fattened off. The lambs for fattening are thenceforth hurdled on arable crops for a period of six to nine months and are drafted for killing, as they become fit, between February and May of the following year. They then weigh from 50 to 55 lb. dead weight. The succession of folding crops starts normally with a broadcast mixture of rape and mustard, followed in October and November by white turnips. In the case of the turnip crop, cultivations are of a cheap order, consisting of horse hoeing and dragging across the drills. Finally, swedes and kale, in separate drills, form the main winter standby from December onwards. The amount of concentrate is kept down to approximately ½ lb. per day until the end of the year, and is raised to 1 lb. or perhaps 1½ lb. only for the last two months.

This system of sheep husbandry has many points to commend it when it is considered as an integral part of the farming policy; it combines a cheap method of maintaining the breeding flock with a high cash return from fat animals; it ensures freedom from lamb parasites as a result of running the lambs on land fresh to sheep; and a large area of arable land receives the benefit of sheep folding. Finally, advantage is taken of the high prolificacy of the Half-bred ewe, an average of 140 lambs to 100 ewes having been weaned over a period of years.

As an experiment a certain number of tegs produced by the Dorset Down ram on the Half-bred ewe have been kept back for breeding purposes. The object is to try to combine the breeding capacity of the female with the quicker-maturing characteristics of the male, and on present evidence results are promising.

A small flock of Dorset Horn sheep was started in 1933. At present this consists of 120 ewes, which number it is intended should be increased to 200. Culling has been carefully and drastically carried out, really first-class rams have been purchased and the present type is singularly attractive.

FIG. 1.—Drilling Wheat.

FIG. 2.—One of the Combines.

FIG. 3.—"Fairview," Leckford Estates.
This land was derelict up till 1935. This Wheat crop (1936) yielded 36 bushels per acre.

FIG. 4.—The same field 1937. A 60-bushel crop of White Marvellous oats.

Lambing takes place in both November and June, and according to present experience a yearly output of 160 to 170 lambs per 100 ewes seems likely to be obtained as an average.

The flock is largely kept on arable crops and the programme is roughly as follows: the November lambing takes place on grass and the ewes and lambs are then brought on to turnips, followed by swedes and kale, until March; April and May are spent on temporary leys, supplemented by mangolds thrown out on the ground, or sometimes on sainfoin; in June the flock moves to trefoil which has been broadcast in the previous year's wheat crop; throughout July and August keep is found on the aftermaths, and finally, in September and October, on a succession of mustard and rape mixtures.

The wether and draft ewe lambs are sold fat at an average age of 16 weeks, when they will kill out at from 38 to 40 lb. weight. Trough feeding both of the ewes and lambs is maintained at a high level.

Thus two contrasting systems of sheep management are in operation on the estate. There appears to be scope to continue with both flocks, which may be said to represent the intensive and extensive systems, and a probability that each will prove its value.

Arable Cropping.

Arable crop production, principally in the form of corn growing, still forms the backbone of the Leckford Estate farming, and sales of crops represent by far the greater portion of the returns. A measure of the importance of cereal crops can be obtained from the fact that, out of a total of 2,700 acres of farming land, an average of 600 acres Wheat, 300 acres Barley and 150 acres Oats are grown. Other sale crops consist of some 40 acres of Dutch white clover and 80 acres of red clover which are harvested for seed, 20 acres of maincrop potatoes and, for the past two years, a mixture of maple peas and oats on about 40 acres of land. There is therefore a total of from 1,200 to 1,300 acres of crops produced for sale.

No hard-and-fast crop rotation is adhered to, and it is a matter of some difficulty to give an accurate idea of the succession of crops in a brief summary; variations within wide limits are introduced not only to suit soil texture and depth, but also on account of the fact that the whole area of land has not yet been in hand for a sufficient length of time for a general routine to be introduced.

Soil fertility is maintained partly by a small acreage of folded root and fodder catch crops, but principally by the use of leys of from two to five years' duration. The chief components of the leys are wild white and broad red clovers, with the addition of

perennial ryegrass and cocksfoot. The fields are closely grazed in rotation by sheep.

Ploughing out of these leys is done in the middle of the summer and the ground thoroughly worked and bastard fallowed before being brought into corn. Wheat is sown on the better land and oats on the thinner soils. Barley is usually taken as the second straw crop and is frequently seeded down to trefoil, red or Dutch white clover, either for folding or seed production. Barley may, however, be followed by roots, or again, the first corn crop be seeded with a leguminous crop or followed by roots. Spring wheat is often brought in after root crops which have been sheep folded. Finally, advantage is taken of the cheapening of cultivation costs as a result of mechanization, and a summer fallow introduced into the rotation.

Autumn wheat, then, is the principal crop grown and is brought in after either temporary ley, fallow or clover. Three varieties are sown, first, Carters' "Quota," which appears to suit the land and combines a heavy yield with a strong straw ; second, "Juliana," which has been tried successfully in the past two years, and is a white wheat of Dutch origin of the Wilhelmina type ; and third, Squareheads Master, which until recent years was the commonest variety in the district. Two spring wheats are used, Little Joss for early sowing and Red Marvel for late use. Normally, Little Joss is not drilled later than mid-February, but in 1937, when the heavy rainfall seriously delayed spring cultivation, fair crops were grown from sowings as late as the middle of March. The inclusion of one bushel of tick beans with the wheat has been made this year and this practice will be developed, for not only is the crop yield increased, but there should be some residual benefit from another leguminous plant.

The land is well suited to the production of malting samples of barley. The only varieties now grown are Bevan's "1935 Plumage" and Webb's "New Cross." The production of a very fine tilth and the length of the growing season appear to be the principal factors in controlling quality, so that in normal seasons the barley will be drilled in February. However, the 1937 season appears to have provided the exception to this rule, and particularly fine malting samples were thrashed from late-sown crops.

Only one variety of oats is grown, namely, Garton's "White Marvellous." This has proved capable of withstanding recent winters when sown in the autumn, has been outstanding as a heavy yielder and possesses a strong straw that does not cause trouble at harvest. The greater part is, however, spring sown, being usually drilled during February.

The mixture of maple peas and oats already referred to has

proved to be worth growing in view of the ready sale for a good sample of these peas. The only disadvantage hitherto encountered has been that the two crops are difficult to ripen at the same time, and there has been a considerable loss of oats through the grain falling out at harvest.

The saving of Dutch white clover for seed has not only proved remunerative but has the advantage that it is ready for cutting at a time between hay and corn harvest, when otherwise work is relatively slack in view of the small acreage of roots grown. Red clover seed is conveniently saved after corn harvest is finished.

Two maincrop potatoes are planted, the acreage being divided between King Edward and Majestic.

In the present year an experimental plot of three acres has been sown with linseed with the object of crushing the seed for home consumption. Present indications seem favourable for a continuation and possible extension of this crop.

Manuring.

In regard to manuring, the amount of dung produced by cattle in the cowsheds and yards is not large, but is sufficient to provide a basal dressing to the potato crop with some to spare for the mangolds.

In addition, a single standard mixture of artificials is especially made up for the estate and is used practically throughout. Every corn crop normally receives a dressing of from 3 to 4 cwt. per acre, and the application is of course increased for roots. The analysis of the mixture shows approximately the following contents of the three manurial ingredients :—

Nitrogen	4 per cent.
Phosphoric acid	8 ,,
Potash	5 ,,

Potash in the form of kainit is always used, and the opinion is strongly held that this, in spite of its extra cost, gives more satisfactory results than any of the purer forms of potash salts. A similar opinion is held by many other successful light-land farmers. The point (which is being investigated experimentally in the area) is a particularly interesting one in view of the fact that there is no experimental evidence, so far, to support this view. It is, of course, possible that some benefit may result from the physical effect of common salt or other components.

The use of nitrogen in the form of spring top dressings is rightly regulated according to the winter rainfall, and in this respect the data from the meteorological station fulfil a very useful purpose. The extent of seasonal variation in recent years is surprisingly great, as may be instanced from the low winter rainfall (from October to March inclusive) of 9·5 inches

in 1933–34 as compared with 26 inches in 1935–36 and 24 inches in 1936–37.

In consideration of these figures the wheat crop in 1934 received no top dressing, but in each of the two following springs a dressing of 2 cwt. per acre was adopted as a standard.

Undoubtedly much of the winter corn throughout the country in 1937 showed clear indications of nitrogen deficiency, and it is certain that greater year-to-year variations might be made with advantage in the amount of nitrogen applied to this and other crops.

Machinery and Implements.

Some brief account of the machinery and implements used on the farms will show the manner in which field work is carried out. The power unit consists of six track-laying tractors, one rubber-tyred light tractor and 16 working horses.

The heaviest work, such as ploughing, cultivating, heavy harrowing, combine harvesting and power binding, in which full use can be made of the power, is carried out by the track tractors; their use obviates both the loss of power associated with wheel spin and any harmful degree of packing of the soil.

It is interesting to note, however, that horses are still found to be the most economical means of performing such operations as broadcasting, harrowing with light seed harrows, swath turning and horse-raking at hay and corn harvest, and carting during harvest, as well as the considerable amount of carting that is inevitable on any mixed farm where much live stock is kept.

Suffolk horses are favoured at Leckford and the normal practice is to purchase colts as two-year-olds, break in on the farm and sell them again when they have reached their highest value at six years old. In this manner it is possible to avoid the heavy charge for depreciation which otherwise adds a good deal to the cost of horse labour.

In regard to soil cultivation, mould-board ploughs are used for autumn work, but one-way disc ploughs of heavy pattern are preferred for summer fallows and for the spring ploughing that is the first stage in preparing the fine seed bed that is wanted for barley and other spring corn.

The ploughs are seldom set to go deeper than five inches, the point being to avoid, as far as possible, bringing charlock seed to the surface; but the importance of stirring the soil deeply is fully appreciated, and the ploughs are therefore followed by the heaviest type of cultivators, which open up the soil to a depth of at least another three inches wherever this is possible, without bringing material at a lower depth to the top.

Hay is made by means of sweeps in the manner which has become the almost invariable practice in the district.

Two combine harvesters are used for the corn, but in addition four binders are kept fully occupied. It has been found that binders are still the most economical way of dealing with reasonably heavy crops of oats, and they are also required where wheat straw is wanted for thatching. Finally, by their use, the harvest can be started earlier, and the work spread over a longer period. During favourable harvest weather as much as possible of the corn is thrashed direct from the stook, to avoid double handling. Two corn driers have been installed, one of the standard vertical pattern which was in most common use a few years ago, and a later one of the horizontal moving-band type. In conjunction with these, storage accommodation has been fitted up for some 2,000 sacks of corn, and in this way an appreciable quantity of grain can, if the early autumn price is unfavourable, be held back and marketed at a later date.

WEEDS AND PESTS.

There are certain major problems associated with crop production which present difficulties, namely, those of dealing with wireworm, charlock and slender foxtail.

On the light chalk wireworm constitutes the most serious objection to the "alternate" form of husbandry, *i.e.*, the use of the long leys. Despite the fact that these leys are amply fed, that the stocking consists of large units of sheep which are kept moving, that the development of tufty coarse patches is further prevented by topping with the mower and that, as already indicated, thorough cultivation and breaking up of the turf is effected before corn drilling, yet there have been areas of corn, in both the last seasons, where wireworm damage was severe. This would seem to be a problem requiring further research, for the treatment at present available on a field scale is virtually confined to consolidation of the land by means of the ring roller and the application of a quick-acting nitrogenous fertilizer.

As already mentioned, the charlock problem has been largely obviated by shallow ploughing. When the weed occurs in barley it is tackled in the seedling stage, wherever possible, by the use of the seed harrows which are used in both directions if necessary. Spraying with sulphuric acid has been found to be effective, but the cost of this operation is appreciable.

An interesting and striking example of the success of sulphuric acid spraying in early May, 1937, was seen over an area of 40 acres which formed part of a 100-acre field of autumn wheat. The wheat plant appeared to be not only backward but unthrifty, and the crop was heavily infested both with corn marigold and black bent grass. The latter was obviously making full use of the spring dressing of nitrogen, and looked like crowding out the wheat entirely. The alternative of ploughing up the crop was

considered, but the result of the spraying fully justified the decision taken. Not only were both weeds practically wiped out, but the corn made rapid growth and, throughout the latter part of the summer, the treated area could be clearly distinguished, even at a considerable distance, by its stronger growth and dark colour. In this case the cost of spraying was amply repaid by the increased yield of wheat alone, apart from its action in weed destruction.

Slender foxtail, however, has been increasing in recent years on most arable farms where the root acreage is being reduced. It seems that summer fallowing is the only sure means of keeping this weed in check.

Conclusion.

The outsider who has been privileged to make periodical tours of the Leckford Estate cannot but be struck by the extraordinary high level of crop production achieved on a soil type which is not ordinarily given credit for much natural fertility. Moreover, the yields are increasing and the absence both of crop failures and dirty land is becoming more striking year by year. This is all the more remarkable in view of the large acreages involved, the absence of a large acreage of expensive root crops, and the fact that most of the work has been "mechanized." Moreover, the appearance of the crops is borne out by the actual yields.

This only confirms the old belief that the basis of successful crop husbandry is thorough cultivation and the skilled eye of the first-rate farmer. This is the real explanation of the success at Leckford. It is impossible, therefore, to pick out specific points of practice—soil treatment, manuring, rotations, or others—which would in themselves account for results.

The deterioration of farming land which is often attributed to so-called "mechanization" is sometimes real and sometimes imaginary. In the former case it sometimes occurs because the farmer concerned has a better knowledge of engineering than of farming. "Mechanization" in itself should enable improved results to be achieved, for it provides a greater opportunity of performing each operation at the correct time. But the requisite farming knowledge is also necessary if the work is to be done better.

A difficulty of similar nature is found in describing the farming system at Leckford as a whole. There are few points of a special or novel kind to be brought out. The fundamental sanity of the policy, the true appreciation of the situation, and the efficient manner in which the work is carried out, are responsible for the present condition of the estate.

In conclusion, enough has been written about Leckford to indicate that the adoption of alternate husbandry and the long ley system, which has been brought so much to the fore in recent years through the work of Professor Stapledon, appear to offer a satisfactory means of maintaining and increasing fertility not only on the Upper Chalk but on the majority of the free-working arable land in this country; provided always that the leys are adequately stocked and grazed by one or more of the various types of live stock which may be best suited to the particular conditions.

Dairy stock, beef cattle and young stock, sheep, pigs and poultry may all find an appropriate place, but in every case the maintenance of prices at an economic level and over a period of years is the primary essential. If this were possible, the production of satisfactory corn crops and the proper use of artificial manures as a supplementary measure in maintaining soil fertility would follow as a natural corollary.

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THE ECONOMIC HISTORY OF TWO RURAL ESTATES IN CAMBRIDGESHIRE, 1870–1934.

THE general conditions that have affected the land-owning interest in this country since the 'seventies of last century are fairly well known, but there have been very few detailed examinations of the financial history of rural estates over a long period of years. This is all the more surprising as the economy of the landlord-and-tenant system has received considerable attention from politicians and others, more especially since the War. The following economic account of two large estates near Cambridge should, therefore, have a topical as well as an historical interest. No less interesting, perhaps, will be the direct comparison of the two properties and of the methods by which they were financed, their dependence on outside sources of income, the maintenance of the permanent equipment and the relative and changing significance of the several sources of income and items of expenditure.

A debt of gratitude is owed by the writer for the facilities and guidance provided at the School of Agriculture, Cambridge University, during 1934–35; to Mr. J. P. Maxton of Oxford for an unpublished thesis on landownership in Scotland, and to the agents and owners who kindly provided the essential information.

FINANCIAL HISTORY OF ESTATE I.

This estate now extends to about 4,200 acres compared with 3,840 acres in 1874. Complete financial details for Block A (1,507 acres) and of Block B (1,055 acres) are available since 1874, and for Block C (of 1,529 acres) since its acquisition in 1903.

Of the two older portions of the estate, Block A consists of four farms and two small-holdings. The farms are devoted to general farming on heavy clay land, and range from 250 acres to 420 acres. Block B consists of 72 small-holdings, while Block C has 76 small-holdings. The holdings range in size from 5 acres upwards, and but few are equipped with buildings.

An interesting feature of this estate is that income from property in the centre of London figures largely in the estate accounts. In the following notes this income—which can properly be regarded as an entirely different form of investment—has been separated (see Table IV.) in order to isolate the factors influencing the rural property.

Gross Income.—The average gross income during the 61 years 1874 to 1934 was about £5,500 per annum; Diagram I. illustrates the fluctuations which have taken place throughout the period, and shows, in a broad way, the trend of the economic

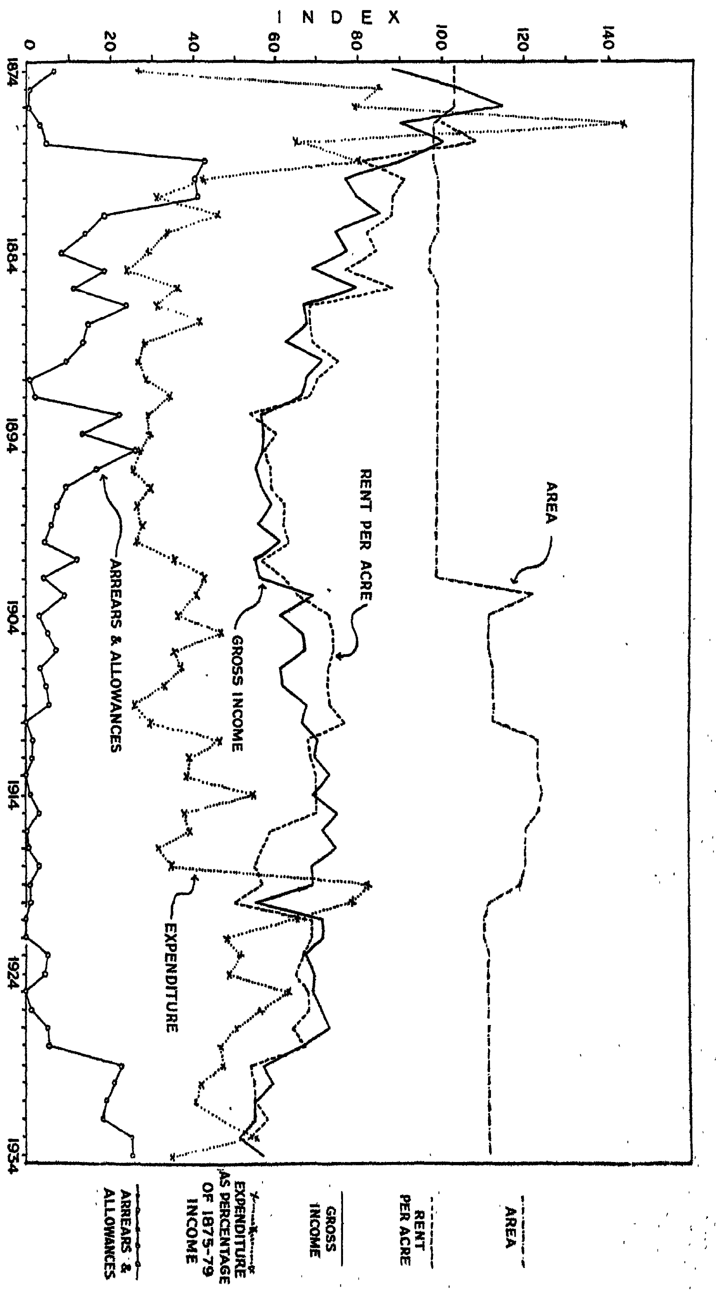

DIAGRAM I.—Indices of (1) Gross Income (1875-9 average = 100). (2) Estate area (1875-9 average = 100). (3) Rent on part of the Estate (1877 = 100). (4) Expenditure as a percentage of the average gross income 1875-9. (5) Arrears and allowances as a percentage of rent due each year. Estate I.

conditions. The decline in gross income after 1885 can be attributed largely to a fall in farm rents. The changes in rent per acre reflect the two agricultural depressions, in the early 'eighties and the 'nineties, respectively, of last century; they show the gradual recovery of rents up to the end of the Great War; the upward movement just after the War; and the effect of the post-War depression.

One of the causes of the rather marked decline in 1911 was that a farm of 421 acres, which had been in hand for over twenty years, was then let at the comparatively low figure of 8*s.* 6*d.* per acre. In 1916 there was a considerable drop in the rental of the higher-priced land on Block B, due to the sale of a large number of homesteads and cottages, the land being afterwards let without buildings. Contributory causes of the recent depression have been the incidence of eel-worm on the market garden lands of this estate, the recurrent droughts and the growing competition of new market-garden areas.

Apart from the decline in rents that marks the periods of depression, there was an increase in arrears and allowances. The exceptionally large amount of arrears during the period 1879–1881 probably resulted from a failure to adjust rents to a level appropriate to the changed conditions. The effect of the post-War depression is also well illustrated, and it is significant that allowances figure in the accounts much more largely than arrears. The giving of abatements has been a matter of policy; abatements can be withdrawn more readily than rents can be raised, the landlord's power to raise rents having been restricted by recent legislation.

Sources other than rents produced a steady, if relatively small, revenue over the period (Diagram II.). In the early years of this account there was a fairly large income in the form of quit rents to the owner, who was lord of two manors until one was sold in 1903. The income from woodlands was largest in the 'seventies and again in the War period. Extensive fellings were carried out in 1875 and 1876 to provide cash to pay off some mortgages, and probably also to finance necessary drainage operations. There has never been any wholesale devastation of the timber resources, and replanting has been done at intervals. Replanting has been especially vigorous in recent years, when advantage has been taken of grants available from the Forestry Commission. The difference between the direct income and expenditure on woodlands, over the whole period, has averaged about £130 per annum, but, obviously, several factors have to be reckoned with before this figure can be regarded as profit.

Although the royalties from sand and gravel have declined, these have provided a fairly constant proportion of the total

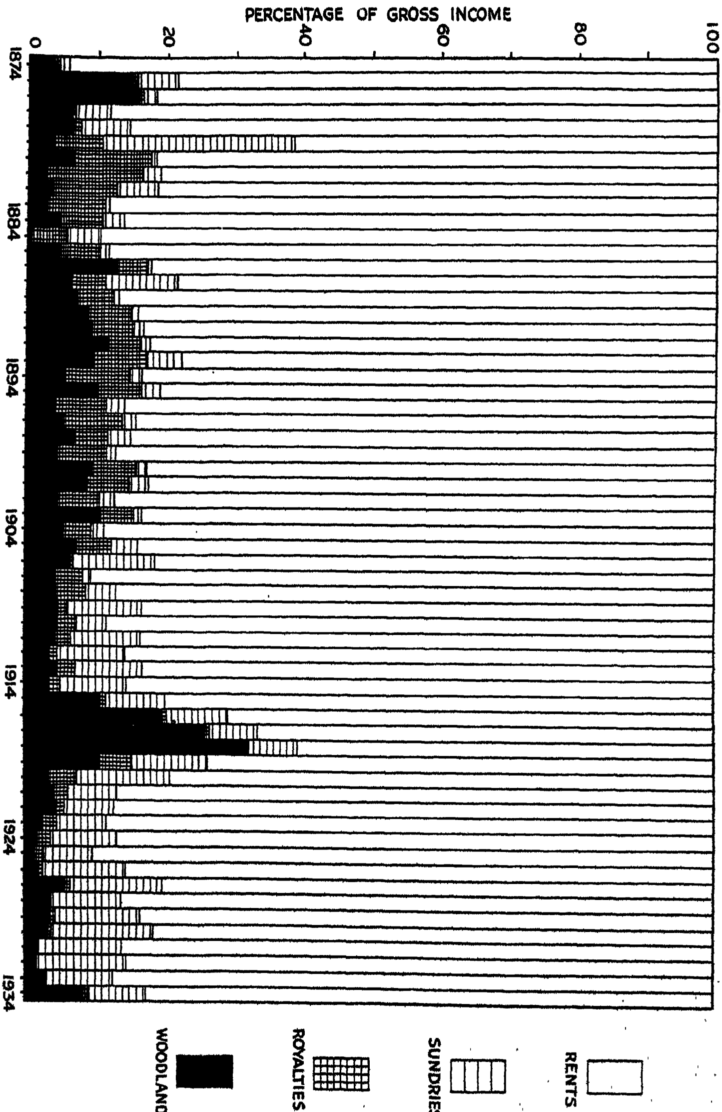

DIAGRAM II.—Gross Income 1874-1934. Estate I.

income. Revenue arising from other sundry items also represents a fairly level proportion of total income because, since about 1909, when the other sources had declined, most of the shooting has been let.

Income and expenditure on land in hand has figured from time to time in the accounts of this estate. In the nine years following 1879 a total net loss of over £1,150 was recorded under this heading. During the present century there has been, with the exception of one large farm, no land in hand until quite recently. In 1934 there were about 100 acres of land in hand.

Taking the gross income over the 61 years, as summarized in Table I., it is found that the total amounted to £339,133, of which agricultural rents represented 83 per cent.

TABLE I.

Total Regular Gross Income in Five-year Periods.

Period.	Agric. Rents.	Wood-lands.	Royal-ties.	Game Shooting.	Manors, Park (let), Land in hand.	Inci-dentals.	Total.
	£	£	£	£	£	£	£
1874 . .	6,714	247	50	24	57	27	7,119
1875–79 .	31,859	3,935	724	789	2,409	366	40,082
1880–84 .	26,306	1,234	3,049	38	695	123	31,445
1885–89 .	23,720	1,714	1,416	19	336	641	27,846
1890–94 .	21,067	2,321	1,690	11	72	430	25,591
1895–99 .	19,252	1,408	1,544	—	232	312	22,748
1900–04 .	20,727	1,926	1,307	—	275	160	24,395
1905–09 .	22,256	1,380	728	335	925	354	25,978
1910–14 .	23,863	1,114	588	1,748	386	297	27,996
1915–19 .	21,252	5,677	365	1,785	613	59	29,751
1920–24 .	23,138	874	573	1,530	645	175	26,935
1925–29 .	23,024	864	222	1,947	500	477	27,034
1930–34 .	18,808	775	98	1,740	559	233	22,213
TOTAL .	281,986	23,469	12,354	9,966	7,704	3,654	339,133
%	83·2	6·9	3·6	2·9	2·3	1·1	100·0

Gross Expenditure.—The relation which the main items of expenditure bear to the total current income is shown in Diagram III. There is a roughly symmetrical curve with the smallest expenditure occuring during the 35 years before the Great War; from 1880 to 1918 the expenditure was generally about 50 per cent. of the income.

In each of the years 1877, 1919, 1920 and 1933 expenditure exceeded income. In the first three of these years the abnormal expenditure was due to a great extension of repairs and improvements; in 1933 to exceptionally large sundry items, including woodlands and game. The downward trend of expenditure in the early part of the period appears to have been due to declining outlays on repairs and improvements. The rise in the post-War years arose partly from the greater cost of improvements and repairs and partly from the increase of public burdens. The net income of the owner was considerably reduced in all the post-War

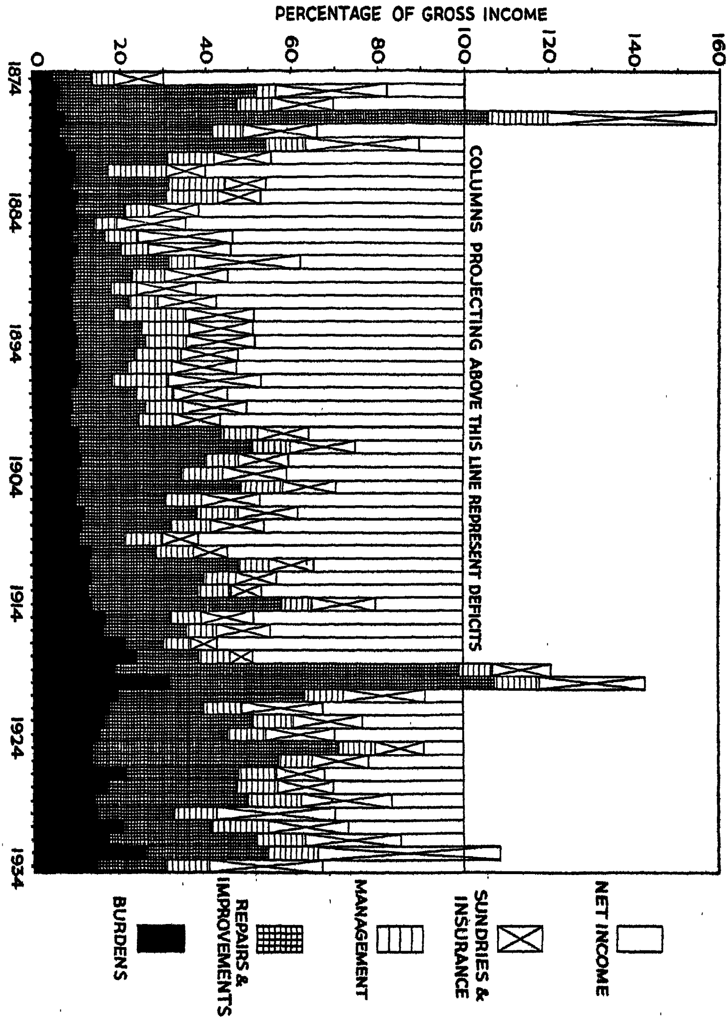

DIAGRAM III.—Expenditure and Net Income 1874-1934. Estate I.

years because, with a declining annual gross income in the more recent years, the ordinary expenditure has tended to increase relatively as well as absolutely (see Diagram I.).

The most notable point in connection with public burdens is the changing amount paid as property tax, after repayments have been deducted. Poor rates and other local taxes represent a small but steady percentage over the whole period. Some of the smaller rates, such as Church and Highway rates, were

merged, by various Local Government Acts, before the end of the nineteenth century. More recently others were merged in the Urban District Council Rate. These rates were levied on the shootings, woodlands, certain of the cottage property, etc. The amount of land tax showed a slight decline over the 60 years of the survey. The decline was not due to redemption, but followed the reduction in rental values and in the area of the estate.

Tithe, included here among the public burdens, is a small charge averaging just over £100 per annum. Only 680 acres out of a total of 4,200 were subject to tithe during the period of the survey. Over the whole 61 years the burdens totalled £40,880, of which Property Tax represented 43·6 and tithe 16·2 per cent. The remaining rates and taxes were (in percentages) as follows :—Land Tax, 20·3 ; Poor Rates, 14·5 ; Water Rate, 1·3 ; Urban District Council Rate, 1·3 ; Special Sanitary Rate, 2·1 ; and the remaining (Church, Highway and Lighting) together 0·7 per cent.

TABLE II.

Average Annual Expenditure on Repairs and Improvements in Five-year Periods (including some Expenditure on Private House and Grounds).

Period.	Repairs.	Extra Buildings.	Draining.	Roads.	Fencing.	Total.	Per cent of Regular Income.
	£	£	£	£	£	£	%
1874 .	597	—	12	38	—	647	9·2
1875–79 .	2,856	—	1,179	108	62	4,025	52·5
1880–84 .	581	164	204	39	55	1,043	16·6
1885–89 .	344	—	225	36	36	641	11·4
1890–94 .	605	—	67	44	35	751	14·7
1895–99 .	509	—	30	24	34	597	13·2
1900–04 .	752	285	140	57	129	1,363	28·0
1905–09	797	180	64	91	76	1,208	23·3
1910–14 .	1,001	316	128	98	72	1,615	29·0
1915–19 .	612	603	163	56	132	1,566	26·5
1920–24 .	1,459	281	152	48	197	2,137	39·7
1925–29 .	1,138	532	177	79	170	2,096	38·9
1930–34 .	671	214	72	36	55	1,048	23·7
Per cent. .	61·0	14·0	15·2	4·0	5·8	100·0	27·2

Table II. shows that the amount spent on improvements and repairs up to 1880 absorbed nearly 50 per cent. of the total income, whereas in the period 1880–1919 it averaged about 20 per cent. It is worth noting that in the years 1877, 1919 and 1920 as much as 99 per cent., 80 per cent. and 65 per cent. respectively of the current income was absorbed by repairs and improvements. In the post-War period, 1920 to 1929, the relative expenditure under these heads increased to nearly 40 per cent. of the total current income. The years of economic

depression are marked by a reduction both in the absolute and the relative expenditure on repairs and improvements.

Some of the repair items appear to refer to the private residence and grounds of the owner. Large items of this personal expenditure have usually been noted in the summary of accounts, and these, where known, have been placed in a supplementary account. In addition to this class of repair, normal to all types of estate, an attempt was made in the three years 1920–22 to carry out some reclamation work which has not been related to the current income in this analysis (Table II.).

In no year, previous to 1915, did insurance absorb more than 2 per cent. of the total income. The reason for the post-War increase is explained by the greater replacement value of the buildings.

The cost of management has been fairly constant throughout the 60 years. Up till 1919 the salary of the agent averaged about 6 per cent. of the total income, while audit expenses were usually less than 1 per cent. With a declining total income the expenses of management assumed slightly greater relative proportions.

TABLE III.

Total Regular Gross Expenditure in Five-year Periods.

Period.	Public Burdens and Tithe.	Imprvs. and Repairs.	Insurance	Manag. Expenses	Sundries.	Total.
	£	£	£	£	£	£
1874	321	647	97	366	705	2,136
1875–79	2,518	21,025	375	3,174	9,316	36,408
1880–84	3,013	5,215	383	3,573	2,879	15,063
1885–89	2,676	3,209	393	1,789	5,004	13,071
1890–94	2,395	3,757	375	1,938	3,449	11,914
1895–99	2,233	2,984	293	2,268	3,224	11,002
1900–04	2,529	6,814	342	2,117	2,793	14,595
1905–09	2,734	6,038	425	2,336	2,808	14,341
1910–14	3,709	8,077	339	2,158	2,490	16,773
1915–19	5,418	7,833	873	2,074	1,990	18,188
1920–24	5,201	10,685	1,093	2,525	3,961	23,465
1925–29	4,099	10,479	920	2,561	2,770	20,829
1930–34	4,035	5,244	948	2,527	4,891	17,645
TOTAL	40,880	92,007	6,856	29,407	46,280	215,430
Per cent.	19·1	42·6	3·2	13·6	21·5	100·0

Direct outlay on woodlands, game and "incidentals" are grouped together as "sundry expenses." Expenditure on woodlands, on the average, slightly exceeded £200 a year. Expenditure on game was relatively stable at about £250 a year up till 1909, after which date it suddenly dropped to an insignificant amount. Since 1909 the sporting rights have mostly been let—the difference between direct income and expenditure averaging

about £300 a year. The expenditure on "incidentals" includes, amongst many other items, legal costs of conveyance, etc.

A summary of the main items of expenditure over the 61 years from 1874 to 1934 is given in Table III., which should be compared with Table I. Total expenditure amounted to approximately £215,000, and absorbed about 64 per cent. of the total income.

Supplementary Receipts.—In addition to the regular receipts, the estate accounts include entries (see Table IV.) which are often self-balancing, in that they appear both on the debit and credit sides. This estate was financed by substantial mortgages in the early part of the period under review, and the figures here considered as "supplementary" indicate, to a certain extent, the manner in which these were paid off. In the early years of the twentieth century a high price was obtained for an outlying part of the estate sold for building development, and this sale financed the purchase of Block C in 1903. The town property of the owner has also been drawn on, from time to time, for capital sums.

TABLE IV.

Total Supplementary Receipts at Estate Office, 1874–1934.

Period.	1874	1875–84	1885–94	1895–04	1905–14	1915–24	1925–34	Total.
	£	£	£	£	£	£	£	£
Cash from Bank / Cash from Owner	1,375	28,263	1,897	166	2,615	29,879	25,527	89,722
Loans & Repayment of Loans	—	—	5,500	1,500	800	12,876	—	20,676
Interest	—	—	439	—	—	11,111	15,849	27,399
Sale of Land or Property	—	—	663	2,267	—	167,033	82	170,045
London Property, (chiefly rents)	2,833	42,742	53,850	59,695	63,300	44,695	12,786	279,901
Miscellaneous	—	—	1,284	399	217	6,710	39,865	48,475
Valuations	—	—	—	363	3,525	—	—	3,888
TOTAL	4,208	71,005	63,633	64,390	70,457	272,304	94,109	640,106

Supplementary Expenditure.—Under this heading are included (1) private and personal transfers, and (2) capital or self-balancing outgoings. If the owner had been wholly dependent on the income from the rural estate the items under (1) would have been paid out of the balance between current estate income and expenditure. But in point of fact this balance was considerably less than the amounts involved, so that other income (see Table IV.) was here absorbed.

Of the sums involved (see Table V.), just over £200,000 went direct to the owner or members of the family. This represented a surplus of over £3,000 per annum. In addition, over £40,000 went to the maintenance of, and payment of rates, etc., upon, the owner's residence, grounds, shooting lodge, etc.

About another £3,000 went to the payment of legacies and other private expenses.

TABLE V.

Total Supplementary Expenditure at Estate Office, 1874–1934.

Period.	1874	1875–84	1885–94	1895–04	1905–14	1915–24	1925–34	Total.
	£	£	£	£	£	£	£	£
Interest . . .	1,928	29,313	39,959	34,148	31,945	12,880	—	150,173
Direct Payments to Owner & Relatives	2,868	32,195	27,017	35,896	43,819	46,734	17,663	206,192
Repayment of Mortgage and loans, etc.	—	—	313	2,153	9,810	88,031	575	100,882
Mansion, Shooting, etc. . . .	144	4,495	2,112	1,537	3,025	6,949	22,234	40,596
Subscriptions and Donations . .	126	2,064	1,274	1,432	944	1,147	2,514	9,501
Invested or Lent .	—	—	1,150	—	200	98,393	35,574	135,317
Valuations . .	—	—	104	—	—	—	1,107	1,211
Property Purchased and expenses .	70	—	757	31,053	1,960	4,964	2,500	41,304
Death Duties .	—	—	—	—	—	—	34,565	34,565
Annual Outgoings* .	2,632	25,950	16,638	3,986	—	—	—	49,206
Reclamation Work .	—	—	—	—	—	5,346	204	5,550
London Property Tax	29	815	1,505	2,520	3,253	10,572	3,339	22,033
Super Tax and Surtax	—	—	—	—	—	4,887	2,258	7,145
TOTAL . .	7,797	94,832	90,829	112,725	94,956	279,903	222,633	803,676

* "Annual Outgoings" consist of jointures, interest on loans, and a few legal expenses.

By the sale of property (again largely town property) at various times, the mortgages and loans were gradually paid off. After 1919 no interest payments appear in the accounts.

An idea of the magnitude of the outgoings can be obtained from the fact that between 1874 and 1919, £150,000 had been spent on interest alone. Mortgages and loans paid back by this time almost reached £100,000, and purchases of property £36,000 (including £30,069 for Block C purchased in 1903). The purchase price obtained for Block C represented about 28 years purchase of the gross rental. The expenses of sales and purchases were just over £3,000. New investments reached £100,000, while the payment of Death Duties involved a single transaction of over £30,000.

In this medley of figures it is perhaps difficult to separate capital from current transactions, but the results of the 61 years may be summarized by stating that the receipts and payments side of the estate accounts each totalled about £1,000,000. On the receipts side, about £340,000 was gross income from the rural property and the remainder of the type described above as "supplementary." Of the expenditure, £215,000 went on the rural estate, and the remainder appears under "supplementary" headings.

ESTATE II.

Financial data are available for this estate since 1870. As with Estate I., the owner was dependent on other sources for a considerable part of his private income.

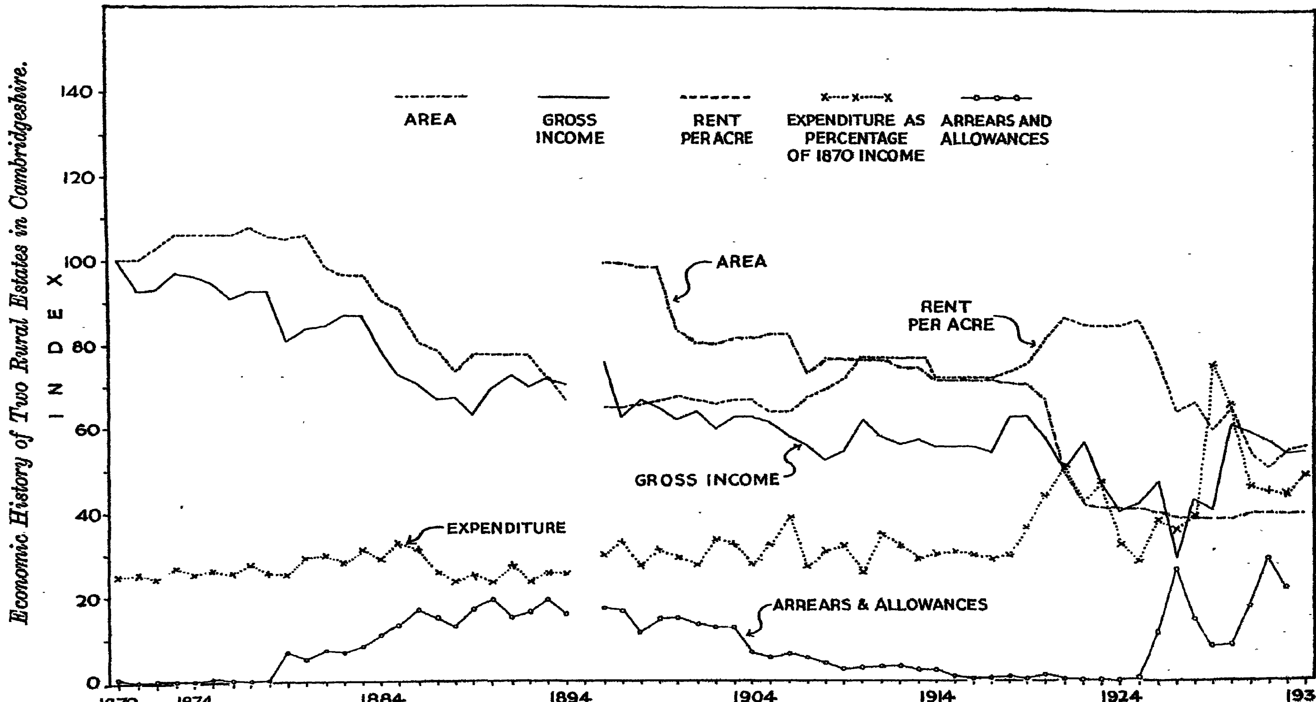

DIAGRAM IV.—Indices of (1) Gross Income (1870 = 100). (2) Area of Farms on Estate (1896 = 100). (3) Rent per acre on some farms (1870 = 100). (4) Expenditure as a percentage of 1870 income. (5) Arrears and allowances as a percentage of rent due. Estate II.

Perhaps the most outstanding change of the whole period on Estate II. is the decline which has occurred in its area, from 13,700 acres in the 'eighties to 5,800 acres in 1934. Conditions on the three blocks of the estate vary widely, both in regard to the type of soil and the size of farms.

Gross Income.—The "regular" income (see Diagram IV.) has shown a very steady decline during the period under review. The increases in the years 1896 and 1929 are exceptional and, in a way, artificial, being due to a change in the system of accounting in these years.

From the evidence available it may be said that the decline in the estate income arose from (1) a decline in rental values and (2) the sale of property. Diagram IV. certainly suggests that the disposal of property was the chief cause in recent years, while the decline in farm rents was the dominant factor during the nineteenth century. Diagram V. reveals the increased importance since 1922 of miscellaneous, or "sundry" items.

The income from rents, other than farm rents, includes, for most years, various house and cottage, public-house, mill, garden and allotment rents. Some idea of the trend of rent per acre is obtained from Diagram IV., which refers to certain farms whose area did not materially change. The diagram shows also the amount of arrears and allowances in relation to the rent due. It is clear how seriously the income of the estate suffered from the beginning of the depression in 1879 and right down to the middle of the first decade of the present century. In the six years 1920–25 there were no arrears, the period resembling that from 1870 to 1878, when, also, arrears and allowances were negligible. Allowances have figured much more prominently in recent years, and in 1931–33 they were on a par with those granted in the depression years 1879, 1880, 1893 and 1894. This experience was shared with Estate I.

Another useful indicator of the changing fortunes of the estate owner is the amount of land in hand from time to time. Over the whole period, land in hand yielded a net balance of about £800. As shown by the Income Tax repayments received, heavy losses on farms were sustained in the post-War years, but the financial details do not appear in the office records.

Woodlands have been one of the more important sources of "miscellaneous" income on this estate (Diagram V.). In 1934 there were about 320 acres of woodlands. Over the 64 years the balance of income over expenditure directly attributed to woodlands was, on the average, about £287 per annum.

The sporting rights were a valuable source of income, but because it was customary to include sporting rights in some of the farm rents, it is impossible to measure the exact totals. Since the War the shooting has been developed considerably,

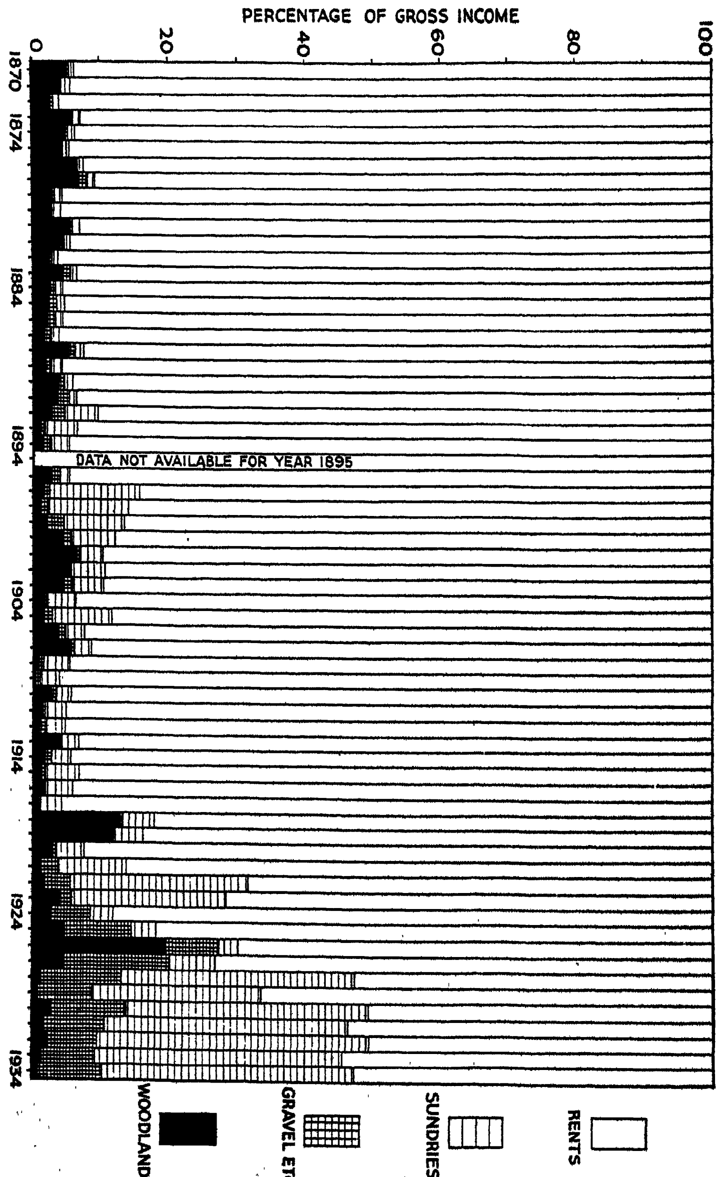

DIAGRAM V.—Gross Income 1870-1934. Estate II.

and although costs have risen, the difference between direct payments and receipts has in recent years averaged over £350 per annum.

A feature of this estate has been the considerable income derived from brickworks and a gravel pit.

The miscellaneous receipts came from garden produce, tolls from stall-letting at a produce market, tithe and quit rents. Tithe income represented from one-eighth to one-fifth of the tithe payments. The quit rents were enfranchized between 1892 and 1894.

Table VI. summarizes the items of "regular" income over the period since 1870, the percentage composition of the grand total being :—Rentals, 87·7 per cent., woods, 3·5 per cent.; game, 4·8 per cent.; gravel and bricks, 1·9 per cent.; tithe, 1·2 per cent.; quit rents, 0·2 per cent.; and miscellaneous, 0·6 per cent.

TABLE VI.

Average Annual Gross Income by Five-year Periods.

Period.	Rents.	Woodlands.	Shooting and Game.	Gravel and Brickworks.	Tithe.	Quit Rents.	Miscell.	Total.
	£	£	£	£	£	£	£	£
1870–74	16,482	927	—	11	214	64	—	17,698
1875–79	17,169	849	—	71	202	11	11	18,313
1880–84	15,957	652	—	89	182	2	2	16,884
1885–89	13,084	364	—	145	156	—	—	13,749
1890–94	13,221	366	—	180	136	241	35	14,179
1896–99*	12,048	252	937	207	126	—	96	13,666
1900–04	11,344	555	424	89	133	—	51	12,596
1905–09	10,596	266	169	101	129	—	191	11,452
1910–14	11,037	228	179	72	133	—	25	11,674
1915–19	10,594	693	308	32	158	—	50	11,835
1920–24	8,251	226	767	283	214	—	401	10,142
1925–29	7,097	541	1,511	1,025	174	—	71	10,419
1930–34	6,137	196	4,088	1,061	159	5	82	11,728
Grand Total for 64 years	753,036	30,319	40,973	16,619	10,456	1,612	4,936	857,961
Per cent.	87·7	3·5	4·8	1·9	1·2	0·2	0·6	100·0

*Four years only ; 1895 missing.

Expenditure.—The trend of "regular" expenditure, illustrated in Diagram VI. is in marked contrast to that of regular income (Diagram V.). In this connection it is important to remember that the annual expenditure is related to an income which has been declining. Thus, in 1870 regular expenditure absorbed less than 25 per cent. of the regular income, while in most of the post-War years it exceeded 70 per cent. of a greatly decreased income. In 1921, 1923, 1927 and 1930 expenditure actually exceeded current income. Over the whole period regular expenditure absorbed about 49 per cent. of regular income.

It is at once apparent that maintenance, improvements and

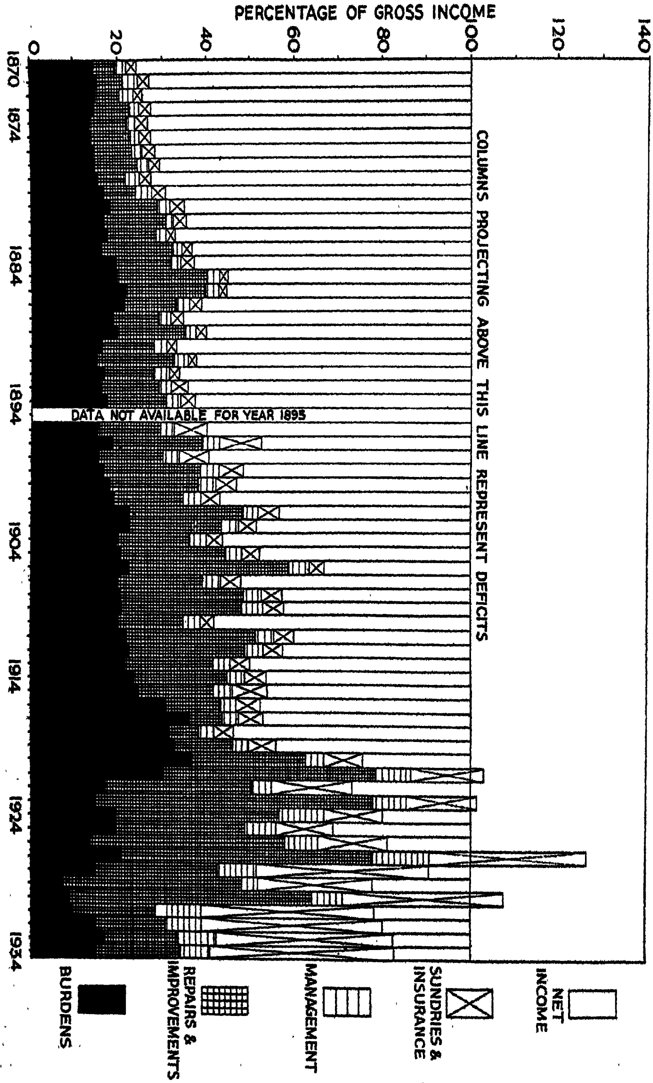

DIAGRAM VI.—Expenditure and net income 1870-1934. Estate II.

public burdens are by far the most important items of expenditure, and that the incidence of these has increased, although the trend of maintenance and improvement expenditure suggests a cyclical tendency.

Among the items here considered as public burdens are property tax, land tax, rates and other fixed charges. Tithe is also included in this class. The proportion which these charges bear to the total income (see Table VIII.) is, in view of the changing area of the estate, more important than the absolute sums.

As has already been mentioned, the system of accountancy on the estate was altered in 1895 from a "credit" to a "cash" basis, and this fact is at least partly responsible for the proportionate drop in public burdens in 1896. By 1922 these burdens, which were very heavy in the War and post-War years, were back at the old level of under 20 per cent.; the reduction arose partly from repayments of income tax on account of maintenance charges and the farming losses already noted, and partly because of an increase in income due to the inclusion of rents for shooting previously kept in hand by the owner. After a low period between 1929 and 1931, the relative weight of burdens again increased.

Tithe is the largest of the items enumerated under burdens. Starting in 1870 at just over 8 per cent. of the total income, tithe paid by the estate showed the expected correlation with corn prices. During the War years and up to 1925 it averaged about 11 to 12 per cent., but since 1926 the effect of redemption, and possibly of the Act of 1925, becomes apparent, and the figure has usually been less than 8 per cent.

The course of the property tax over the period is of interest in showing the increasing weight with which this burden pressed on the owner of the estate. In the 1870's it equalled less than 2 per cent. of the total income, and, indeed, in some of these early years it was under 1 per cent. Up till 1900 it approximated 2 per cent., but for the first 14 years of the present century it varied between 3½ and 5½ per cent. In 1913 repayment claims began to appear in the accounts, but despite this the burden of property tax rose sharply, and in the six years, 1916–21, it represented from 10½ to 16 per cent. of the total income.

Land tax is a burden which shows remarkable constancy over the period. Except for more recent years it normally varied between 2 and 3 per cent. of the total income and, so far as is known, redemption has not been undertaken. The other burdens include rates and some small permanent payments. Up till the end of the last century these formed a constant, though small, proportion of the total income, and in most cases did not exceed 2 or 3 per cent. In the present century the incidence of these burdens has somewhat increased.

Under "improvements and repairs" are included materials and new buildings and drainage, as well as the wages paid to the estate staff employed on such work. Appreciable amounts

of this expenditure appear to be chargeable to a private residence. Three levels of increasing expenditure are apparent in Diagram VI. From 1870 to 1894 the expenditure represented about 11 per cent. of the total regular income; from 1896 to 1920 it was about 20 per cent.; in the third period from 1921 to 1934 the comparable figure was about 37 per cent. One reason for the post-War increase was that the arrears of maintenance which accumulated during the War had to be made good. The figures in Table VII. show that, in spite of a declining income, the absolute amount spent on the various classes of improvements and repairs shows a tendency to increase. Naturally enough, some of the increased post-War expenditure would be due to enhanced unit costs, but there is evidence that there was an increasing volume of repairs and improvements undertaken. In this connection special reference may be made to the years 1929 and 1930, when 42 and 56 per cent. respectively of the current income was spent on repairs and improvements. The reason for this large outlay is given in a short note by the agent:

> "Several farms and all farm houses which had been in hand or unlet were re-let in 1928/9 and 1930. Expensive alterations and renovations were undertaken for new tenants. Houses were enlarged and modernized; new bathrooms were installed; new cottages erected. Changed methods of farming were apparent at this period; much arable land laid down to grass required new or improved fencing on an extensive scale; also, improved water supplies to farms and new grasslands were required. Farm buildings had to be modified to meet these changed methods and, in particular, increased accommodation was required for cows, which in turn meant providing properly equipped dairies. Thus, on one farm, for example, a new cowshed to accommodate 82 cows was erected (1929), in addition to altering some of the existing buildings for more cows. Similar alterations (on a smaller scale) were carried out on other farms. Large Dutch barns were also erected at some farms for new tenants."

Expenditure on repairs and improvements were shown in greater detail after 1895 (see Table VII.), but the figures require some explanation. The section "drainage and improvements" contains only small amounts for drainage. "General estate repairs" include those items which could not be charged against any particular holding.

In addition to the expenditure shown in Table VII., a further £6,700 was paid out, chiefly for work done and taxes paid by tenants (Table IX.). On the other hand, the estate from time to time received sums for work done, amounting in all to £4,400. As indicated in Table VIII., insurance premiums have always been for small amounts.

In recent years some of the work formerly performed by the estate foreman or clerk of works has been carried out by the management staff, so that the management expenses now include a proportion of expenditure formerly charged to repairs, etc.

TABLE VII.

Summary, by Five-year Periods, of Total Expenditure on Improvements and Repairs.

Period.	Repairs, Materials and Repair Staff.	New Bldgs.	Drainage and Imprvs.	Reprs. to cottages.	Gen. Estate Reprs.	Total.	As per cent. of total Income.
	£	£	£	£	£	£	%
1870–74	5,606	679	—	—	—	6,285	7·1
1875–79	7,362	90	—	—	—	7,452	8·2
1880–84	10,182	—	554	—	—	10,736	12·7
1885–89	10,335	—	323	—	—	10,658	12·0
1890–94	9,100	—	211	—	—	9,311	13·1
1896–99*	4,732	1,644	1,723	514	1,031	9,644	17·6
1900–04	5,161	1,814	2,225	985	2,267	12,452	19·9
1905–09	7,638	2,666	2,436	604	2,021	15,365	26·6
1910–14	7,041	1,578	1,003	1,233	2,056	12,911	22·1
1915–19	4,620	267	375	724	625	6,611	11·2
1920–24	17,651	—	1,086	864	1,196	20,797	41·0
1925–29	11,817	7,186	303	790	608	20,704	39·7
1930–34	12,211	3,023	—	—	2	15,236	26·0
TOTAL	113,456	18,947	10,239	5,714	9,806	158,162	18·4
Per cent. of Total.	71·8	12·0	6·4	3·6	6·2	100·0	—

*Four years only; 1895 missing.

Since the recent formation of the estate into a Company, directors' fees are included under management; also auditors' fees, etc. Up till 1894 the total "expenses of management" absorbed less than 3 per cent. of the current income, and the average annual amount spent during these first 25 years was under £500. In the post-War years, with the exception of 1927, the comparable figure was about 6 or 7 per cent.

"Miscellaneous expenses" include such items as direct outlay on woodlands, game, quit rents, gravel-pits, brickworks, and some general estate labour. After 1894 the "sundry" expenditure increased considerably, probably because it included various details formerly entered under a different heading. The increase of recent years has been largely due to extension of the gravel works, development of the shooting, and the planting up of new woodlands.

The foregoing discussion on the various items of "regular" expenditure is summarized in Table VIII. The total expenditure over the 64 years represents about 49 per cent. of the "regular" income.

Supplementary Receipts.—On this estate the sums shown under "supplementary receipts" have been very considerable, and the largest item is for advances (over £61,000) made by the owner to the estate account. This was to a large extent part of the sums received from sales of estate property, although a proportion of it was a loan. It has already been mentioned that the receipts from sales of property have not figured in the accounts, except occasionally as deposits on purchase money. It is

TABLE VIII.

Average Annual Expenditure by Five-year Periods, 1870–1934.

Period.	Public Burdens.	Repairs and Improvements.	Insurance.	Miscell.	Management.	Total.
	£	£	£	£	£	£
1870–74	2,796	1,257	15	457	529	5,054
1875–79	2,688	1,490	18	483	534	5,213
1880–84	2,970	2,147	27	385	392	5,921
1885–89	2,745	2,131	26	282	385	5,569
1890–94	2,334	1,862	79	320	438	5,033
1896–99*	2,232	2,411	161	906	457	6,167
1900–04	2,563	2,490	134	406	455	6,048
1905–09	2,408	3,073	121	399	470	6,471
1910–14	2,563	2,582	142	356	474	6,117
1915–19	3,683	1,322	159	337	458	5,959
1920–24	2,408	4,159	243	1,244	650	8,704
1925–29	1,314	4,141	204	2,441	701	8,801
1930–34	1,442	3,047	242	4,436	951	10,118
TOTAL	158,501	158,161	7,698	61,349	33,996	419,705
Per cent. of regular Income	18·5	18·4	0·9	7·1	4·0	48·9
Per cent. of regular Expenditure	37·8	37·7	1·8	14·6	8·1	100·0

*Four years only ; 1895 missing.

TABLE IX.

Supplementary Receipts : Usually Irregular, Self-cancelling, Private or Capital.

Type of Receipt.	Total 1870-1934.
	£
From owner and from some sales of property	61,528
*Net Income from farms in hand (certain years only)	7,800
Loans from agricultural credit companies	1,770
Capital and interest	3,180
Repayments for work done for tenants	4,408
Fire insurance claims	2,609
†Repayments of rates, taxes, insurance, etc.	3,667
Farm valuations	10,729
Miscellaneous	2,267
TOTAL	97,978

*It is not possible to classify these sums into their appropriate categories, otherwise they would be deducted from the specific burdens. A similar difficulty occurs in Table X., page 161, where certain allowances to tenants for work done and taxes paid are not distinguishable.

†This item is not complete, as the post-War losses were not recorded in the estate office.

possible, however, to get some idea of the extent of these sales from notes in the estate rental since 1896. Up to March, 1920—when the purchase price was noted—6,644 acres had realized £157,000, which represented 28·3 years purchase of the gross rentals. Actually the total area of land sold between 1896 and 1934 was about 9,000 acres, which represented a total rental value of over £8,000 at the time of sale.

TABLE X.

Total Supplementary Expenditure: Usually Irregular, Self-cancelling, Private or Capital.

Description of Expenditure.	Total 1870–1934.
	£
Gross private drawings in cash, including repayment of loans to estate office	455,046
House, garden and stables	23,820
Pensions, subscriptions and donations	4,097
Interest, bank charges	9,065
Capital advances	10,267
Farm valuations	8,517
Sale price of land (passed on to solicitors)	8,538
*Allowances	6,700
Miscellaneous	2,120
Total	528,170

*These allowances, shown in the expenditure side of the accounts, appear mostly for taxes or work done by tenants and are not remissions of rent. If separable, the work done would be treated as expenses or maintenance.

Supplementary Expenditure.—By far the largest item of "supplementary expenditure" is the private drawings of the owner, to which expenditure on house, gardens and stables might be added, since these were incurred largely in improving the amenity of the residence. The net remittances by the estate to the owner have latterly declined to less than half their level in 1870. This is due to a combination of causes of which the most important are :—(1) Since the eighteen 'nineties the estate has declined in area ; (2) the gross rents of the farms have declined ; (3) the expenditure on public burdens and repairs and improvements has tended, on the whole, to increase absolutely as well as relatively. It must be remembered, however, that capital sums realized from the sale of property did not always appear in the accounts, and that presumably the proceeds have been invested privately by the owner.

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REPORT OF THE RESEARCH COMMITTEE.

THE Society's Research Committee has again during the past year provided funds for a considerable number of research projects.

I.—WORK COMPLETED.

The pig feeding experiments at Cambridge University Farm have been completed and a final report by Mr. W. S. Mansfield is appended (p. 172). The experiments dealt with the effect of limiting the ration of the pig on the economy of live-weight increase, the quality of the carcase, and the financial returns.

The work on the disposal of sugar-beet by-products at the Norfolk Agricultural Station has also been concluded. The last series of trials dealt with the use of wet sugar-beet pulp (both fresh and ensiled) in bullock feeding. This report is also appended (p. 186).

II.—WORK CONTINUED FROM PREVIOUS YEARS.

RESEARCH INSTITUTE IN ANIMAL PATHOLOGY, ROYAL VETERINARY COLLEGE, LONDON.

DISEASES OF YOUNG CALVES.

It was pointed out in last year's report that the condition known as "white scours" or colibacillosis was definitely responsible for the death of 37 out of 100 calves collected and examined soon after death, and probably for six deaths more. During the current year a study of the bacteria isolated in the course of that survey has been made.

Although the organism responsible for colibacillosis, namely, *Bacterium coli*, is associated with such diseases of young stock as white scours, it is also a normal inhabitant of the intestines of man and animals. The fact that *Bacterium coli* is present in healthy animals makes the problem of colibacillosis more complicated than that presented by, for instance, anthrax, in which the finding of *B. anthracis* is sufficient to establish the cause of the disease. Also colibacillosis is a difficult problem because the structure of *Bacterium coli* varies; in fact we are dealing, from the bacteriological point of view, not with a disease caused by one type of organism, but with a disease which may be caused by any one of many types. The field of investigation therefore becomes narrower, and the next problem presenting itself is that of identifying and classifying those strains of *Bacterium coli* isolated from diseased calves. If this can be done, then it will be possible to determine whether special disease-producing races of *Bacterium coli* exist, and, if so, to what extent they cause diseases in young calves. It should also be possible to discover whether

one or more of these races predominate in a particular herd or area.

With these objects in view, those strains of *Bacterium coli* isolated during the survey were subjected to various laboratory tests. In work of this kind certain tests of a biochemical nature are in current use, but these were unsuccessful with the strains in question, which all reacted in the same way as did *Bacterium coli* which is normally found in cow-dung. More searching tests, namely, serological reactions, were then applied, but difficulties were encountered because, in such work, the rapid changes which some strains undergo under artificial cultivation invalidate the results. The test finally adopted in order to display the structure of the bacterium consisted of a precipitation reaction, in which chemical extracts of the organism were used. The results showed that, out of 110 strains from diseased calves, 79 fell into one or other of eight types. It appears, therefore, (*a*) that special races of *Bacterium coli* which produce disease in calves do exist, (*b*) that in some instances more than one race may exist in a particular herd, and (*c*) that usually one type only is concerned in the death of an individual calf.

An account of this aspect of the work has been published (Lovell, R., 1937. *Journal of Pathology and Bacteriology*, xliv, 125–139).

ROTHAMSTED EXPERIMENTAL STATION.

The Use of Electrical Power.

Threshing.

The crops available for threshing comparisons between the 20 h.p. motor and International tractors as sources of power were stacked, as usual, in the Dutch barns until the farm staff should have the time available to deal with them. Pressure of other work, however, resulted in an unusually long period of storage, after which, in the opinion of the farm manager, the damage caused by rats was so extensive as to render these crops unsuitable for the power comparisons. Consequently no threshing measurements were made.

Hand Labour and Electric Motor.

A comparison between hand labour and electric drive was carried out in the sorting of some 13 tons of potatoes. The experiments were of one hour's duration, using the two forms of power alternately. The potato sorter was a model manufactured by Messrs. Cooch & Sons, Northampton, and designed for a power drive. The necessary additional parts for hand labour were fitted when required and functioned satisfactorily. The motor used was a G.E.C. $\frac{1}{2}$ h.p. repulsion-induction motor, which gave a speed of 190 r.p.m. to the driver shaft of the sorter. The average

speed for all hand-drive experiments was 184 r.p.m. For any one experiment one man drove the sorter throughout, and in general the speed of the sorter decreased slightly throughout the run. Had the experiments lasted for longer periods of time under similar conditions, the comparisons of speeds of working would probably have been unfavourable to hand labour.

The electricity consumption for one hour's working was naturally small—of the order of one-third of a unit—and was found by timing the rate of revolution of the meter disc at frequent intervals; in addition, the meter was read to ·01 of a unit at the beginning and end of the run (this entailed estimating the position of the pointer on the 0·1 unit dial). Consumptions varied from 0·30 to 0·34 units (estimated), the range for the direct reading of the meter being 0·31 to 0·36 of a unit.

At $\frac{1}{2}$d. per unit the power cost corresponds to $\frac{1}{6}$d., as compared with 8d. for the extra man required for the hand drive.

The average weight of potatoes sorted in one hour was 32 cwt. For individual experiments, however, the figures varied from 25 to 37 cwt., which illustrate the effect of the two main factors bearing on the rate of work, *i.e.*, the industry of the man feeding the potatoes to the sorter, and the speed of the sorter. In the experiments with the motor (constant speed) the outputs for three men feeding the sorter were 25 cwt., 31 cwt., and 36 cwt. respectively.

With the same man feeding the sorter in all hand-drive experiments, the output increased regularly with the speed of the sorter.

Grazing Trial on Manurial Residues of Cake Feeding.

In order to measure the manurial value of cake residues on grassland an experiment was planned in three blocks, each of three plots. When the experiment is in full swing, it is proposed to compare, each year, (*a*) land with the residues of cake fed in the preceding year against (*b*) land with manures equal to the estimated manurial value of the cake, and (*c*) land with neither cake residues nor manures. A second set of three plots will give the second year residual effects, while one plot in the third set will be receiving cake in preparation for the following year. The experiment thus consists of nine plots, each of which is about 5 acres.

In 1937 all plots were treated alike in order to make an opportunity to develop the technique and also to measure the irregularity of the land.

The plots and roads were fenced off between March 25th and mid-May, using iron standards and five rows of plain galvanized wire and wooden gates, with railway sleepers for posts. A water

supply from a main was provided on each plot through $\frac{3}{4}$-inch piping, drawn into the soil at a depth of 20 inches behind a mole plough pulled by a traction engine. All plots were chain-harrowed both ways between April 20th and 28th, and basic slag (14 per cent. P_2O_5, 90 per cent. citric acid solubility) was applied between April 28th and May 3rd at the rate of 10 cwt. per acre to randomly chosen halves of each plot.

A pair of beasts was put on each plot on May 18th, and a second pair added on May 26th as the grass was growing away. On June 7th and 8th a weighbridge was erected on an odd piece of land in the centre of the field, and at the end of June a shed and collecting pens were erected. On July 7th the weighbridge was used for the first time and sheep were introduced. The stocking over the whole period, and the live-weight increases on each plot, are given below. They show that the differences between plots were considerable, and illustrate very well the difficulty of conducting reliable grazing trials.

In the future experimental years, the data from this year's uniformity trial may serve to smooth out some of the irregularities, provided that similarly treated plots show differences comparable with those from uniform treatment in 1937.

STOCKING PER PLOT OF 5 ACRES.

	Cattle.	*Sheep.*
May 22nd—May 26th	2	—
May 26th—July 7th	4	—
July 7th—July 21st	3	6
July 21st—August 5th	2	6
August 5th—August 19th	2	6
September 10th—September 23rd	1	3
September 23rd—October 1st	1	3
Total grazing days per plot	297*	321

*289 cattle days only on Plot 5.

TOTAL LIVE-WEIGHT INCREASES IN LB. PER PLOT.

Plot.	*Cattle.* *May 18th—July 7th.*	*Cattle.* *July 7th—October 1st.*	*Total Cattle.*	*Sheep.* *July 7th—October 1st.*
1	671	139	810	41
2	653	116	769	58
3	506	155	661	22
4	485	101	586	32
5	407	53	460	67
6	549	90	639	25
7	531	83	614	39
8	502	95	597	6
9	618	113	731	4

BACTERIOLOGY DEPARTMENT.

SUMMARY OF WORK ON LEGUMINOUS PLANTS CARRIED OUT IN 1937.

EFFECTIVE AND NON-EFFECTIVE STRAINS OF NODULE BACTERIA.

The occurrence in soil of nodule bacteria which produce no benefit to the host plant is a fact whose practical importance is increased by the discovery that these useless strains can compete for nodule formation with beneficial strains. This fact probably explains the failure of legumes in certain soils containing a preponderance of non-effective nodule bacteria, and introduces an unforeseen difficulty in overcoming the failure of legume crops by "inoculation." Such non-effective strains have been studied in the case of clover, peas and soya beans, but are probably prevalent in other legumes as well. This year's analysis of the causes of competition between strains has revealed two important facts.

In the first place, strong competition between the bacteria takes place outside the plant. Thus when peas were grown in sand supplied with beneficial and non-effective nodule bacteria in equal numbers, the non-effective strain increased, but entirely prevented the multiplication of the effective strains, and this although the two strains increased equally when grown separately. This discovery, that competition between strains of nodule bacteria takes place outside the plant, is of possible practical importance since further investigation may enable us so to alter the soil conditions as to favour the growth of the good strains, at the expense of those that are useless to the plant. Further study is proceeding along these lines.

In the second place, our experiments have shown the importance of the period of time required by the organism to produce nodules. This differs very considerably in different strains. Two strains of clover nodule bacteria have been studied, both of which, in pure culture, are equally beneficial to the host. One of these begins to produce nodules within about ten days from the time of sowing the clover, and this strain competes successfully with a non-effective strain applied simultaneously to the root surroundings. The second strain takes a fortnight longer to produce the first nodules and is unable to compete with the non-effective strain. This time factor is thus of considerable importance in selecting a strain of nodule bacteria for commercial use in seed inoculation ; it has not hitherto been considered in this connection.

A study has also been made of the structure of nodules produced by effective and non-effective bacterial strains respectively. The non-effective nodules are abnormal but differ in their

abnormalities in different host plants; those in clover are characterized by an abnormal appearance of the contained bacteria, whilst in soya beans the non-effective bacteria remain in the intercellular spaces and do not, like the beneficial strains, invade the host cells and multiply there. It thus appears that failure of a strain to benefit the host plant may be due to more than one type of abnormality.

There is some evidence, however, that the juices of roots which bear non-effective nodules contain a substance inhibitory to the growth of nodule bacteria, a further study of which may lead to an explanation of non-effectiveness.

It would seem very desirable to make a survey of the distribution over Great Britain of non-effective strains of bacteria in clover nodules, and perhaps also in other legumes, in order to assess their practical importance and to find out in what districts and on what types of soil they are most abundant.

NORFOLK AGRICULTURAL STATION.

An Investigation into the Cumulative Effects on a Light Arable Soil of Various Methods for the Disposal of Beet Tops and Straw.

The series of three rotational experiments dealing with the disposal of sugar-beet tops and straw, which was commenced in 1936, has been continued during the past year, and has now been extended to include a fourth experiment, in order that each crop in a four-course rotation (sugar beet, barley, hay, wheat) may be studied each year. Besides obtaining evidence on the economic utilization of these by-products, it is hoped by this means that some indication will be obtained of the variations due to climatic conditions. A summary of the fundamental principles underlying this series of experiments, together with the twelve treatments involved, was published in last year's issue of this *Journal*. Each of the experiments will continue through a complete rotation, since it is expected that the manurial value of the tops and straw will be distributed over a number of years.

In spite of a considerable difference in the weather conditions of 1936 and 1937, and although the yields for 1937 were materially lower than those of the preceding year, results obtained in the two years show a striking similarity. Until the conclusion of the rotation it is impossible to draw strict comparisons between the treatments from year to year; nevertheless, it is possible, at the end of the second year, to observe differences due to the individual treatments which have already been completed.

The disposal of beet tops, either by feeding to sheep or by ploughing in, has now been repeated for a second year and, in spite of somewhat unfavourable conditions in 1937, the results

obtained in the two years are in very close agreement. Ploughing in or feeding the tops has resulted in higher yields of grain and straw, in the succeeding barley crop, than those of plots from which the tops have been carted off for bullock feeding. Similarly, the two years' results agree that the manurial residues following ploughing in are greater than those remaining in the sheepfold. This increase persisted into the second year, when the yields of hay from the "tops on" plots were substantially higher than those from corresponding controls. Similar results from the sheeping of the tops could not be obtained in this experiment, since no yields of hay were measured, the whole of the "seeds" on those plots being consumed by sheep. Sheeping the "seeds," in contrast to sheeping the beet tops, has produced no increase in the following crop in the rotation, the yields of wheat being identical on all plots. This indicates that the treatment of the "seeds" crop should be determined by the relative values of the "seeds" for hay or for sheep feeding.

Ploughing in straw, either as farmyard manure or in the unrotted condition, has been combined with each of the methods for the disposal of beet tops, but no interactions between the two sets of treatments have been obtained up to the present. The methods of straw disposal can therefore be treated individually. Applications of farmyard manure to the wheat and sugar-beet crops have given large responses during the first year, presumably owing to the supply of readily available nitrogen. In the second year of the rotation, however, the increases in yield have been small, and have failed to reach the level required for statistical significance. It should be pointed out, however, that the wet spring of 1937 may have caused serious losses through leaching; hence confirmation of this result by future years' work is essential. It was hoped that similar results would be obtained from straw spread in the sheep fold and rotted by admixture with the sheep manure. However, no increase in yield of wheat resulted from this treatment, which may indicate that the rotting of the straw had not proceeded fast enough for the manurial constituents to be available for the immediately succeeding crop.

The high responses in the first year following the application of straw may prove rather misleading unless it is noted that, with each application, the plots receive a dressing of sulphate of ammonia equivalent to three-quarters of a hundredweight per ton of straw. This has been given in order to replace the available soil nitrogen which is locked up during decomposition of the straw. The dressing of artificial nitrogen has had the effect of producing very large increases in each crop to which it has been applied, masking the actual treatment effect due to the straw.

By the end of the first year, however, it can be assumed that the supply of artificial nitrogen has been exhausted, and hence that any increases which may be obtained during the succeeding years will be due entirely to organic manurial residues. Results from the two experiments which have completed the second year of the rotation indicate that the manurial value of the straw extends over the second year following the application, the magnitude of the response being slightly larger than that obtained from farmyard manure under similar conditions. How long this increase in yield, following applications of straw, will be maintained must depend on the rate of decomposition of the straw; at the end of the first year very little decomposition had occurred, but by the end of the second year it was impossible to distinguish any trace of undecomposed material in the soil.

UNIVERSITY OF DURHAM.

(*King's College, Newcastle-on-Tyne*).

THE CONTROL OF THE SHEEP TICK.

In the last volume of the Society's *Journal* an article appeared entitled "Control of Sheep Ticks." The following conclusions were drawn from the results of field experiments :—

(1) Ticks constitute a serious menace to sheep rearing in upland areas. Ticks transmit the causal agents of two serious diseases, viz., Louping ill and tick-borne fever, while they are also, in all probability, responsible for much wastage in lambs due to septic infections.

(2) A new "anti-tick" dip which has been tested appears to act as a deterrent against reinfestation. It is suggested that this dip may be used to control ticks without unduly upsetting the ordinary routine of sheep management.

During the 1937 tick season this work has been extended, and Mr. Lyle Stewart, M.R.C.V.S., in conjunction with the staff of the Cooper Technical Bureau, has tested and compared the deterrent actions of several anti-tick dips. Facilities for this work were obtained on three tick-infested sheep farms, and five dips were tested.

1. Dip A. An arsenic-cresylic-derris dip, in a wool grease base.
2. Dip B. Similar in type to Dip A, but containing an inferior type of derris and differing in some technical details of its preparation.
3. Dip C. A well-known standard arsenical dip.
4. Dip E. An arsenic-carbolic-derris dip, in a wool grease base.
5. Dip F. A cresylic acid dip containing pine-tar oil and wool grease, dissolved in mineral oil.

Dippings were carried out at approximately three-weekly intervals during the tick season, both ewes and young lambs being dipped. Tick counts were made at weekly intervals on both dipped and undipped sheep. All lambs found dead during the course of the experiments were retained for post-mortem examination.

Results.

It appears that dips compounded with wool grease have a high protection value for a period of two to three weeks after dipping, as compared with a protection of one to three weeks for the standard arsenical paste dip. The best results were obtained with Dips A and E. Dips C and F gave the poorest protection, and Dip B was placed intermediately. Dips A, B and C were tested on three groups of sheep on the same farm, and the lowest death rate among the lambs was observed in the stock dipped with Dip A. It cannot be said with certainty that this resulted from the use of Dip A, but it is quite possible that this may have been so.

Observations.

On the above farm 54 strong lambs (out of a total of 325) died during the tick season and all were examined post-mortem. Thirty-four lambs (or 63 per cent. of those examined) showed marked evidence of pyæmia (septic infection) characterized by multiple abscesses throughout the internal organs, and caused by a staphylococcus-like micro-organism introduced through the skin, either by the tick itself or as the result of tick bites.

This was regarded as a striking finding, inasmuch as, hitherto, the high mortality had been ascribed to louping ill. This was found not to be the case, and it is clear that louping-ill vaccination was contra-indicated. Further, the experiments indicated that any material improvement in the lamb crop on many tick-infested farms must await the results of future experiments designed to keep ticks from young lambs from the time of birth until they can be immersed in an "anti-tick" dip. Dipping can be done without much trouble three weeks after the commencement of the lambing season, but only with great difficulty before this time. Meanwhile, many lambs may be infected, and ways and means must be found of treating lambs during the first three weeks of life.

Future Work.

Results of great interest have already been obtained, and it is intended to prosecute these studies next tick season. The active co-operation of the staff of the Cooper Technical Bureau has been obtained, and derris powders and dips will be used

under controlled conditions, when the resulting effects on the tick population will be correlated with the death rate and the percentage lamb crop.

UNIVERSITY COLLEGE OF WALES, ABERYSTWYTH.

TRIALS OF GRASS SEED MIXTURES.

The object of this series of trials, as has been explained in previous reports, is to compare grass seed mixtures composed mainly of pedigree indigenous strains with others composed of the ordinary strains of commerce. The year 1936 was devoted to the production of a supply of seeds of the indigenous strains and the trials themselves were laid down in the spring of 1937.

Altogether plots have been laid down at 22 centres distributed over the counties of Middlesex (3), Wiltshire (3), Somerset (3), Gloucester (3), Worcester (2), Shropshire (2), Cheshire (3), Lancashire (2), and Hereford (2). The total acreage sown with indigenous seeds is 88¼ acres, and at each centre a strip of land has been sown with commercial seeds. A considerable number of other trials on precisely similar lines have been laid down by county agricultural organizers or by private farmers.

County organizers reported in the autumn that the early establishment of the seed had been generally good, and that in some places good swards seemed to be already assured. At one centre (in Hereford) the drought had rather seriously affected the plots and although the grasses were making some recovery in the autumn, the successful establishment of the clovers was still doubtful.

Mr. Trefor Thomas of the Welsh Plant Breeding Station visited and approved all the centres in consultation with the agricultural organizers concerned.

The plots will be kept under close observation during 1938.

FINAL REPORT OF PIG FEEDING EXPERIMENT CONDUCTED ON THE CAMBRIDGE UNIVERSITY FARM IN 1935 AND 1936.

IN the *Journal* of the Society for 1935 (p. 137) an interim report was published of a pig feeding experiment begun in that year. The experiment, involving as it did the individual feeding of 100 pigs from weaning to bacon weight, was done in three parts and was not completed until December, 1936. The interim report referred to the first group of forty pigs. Since then the trial with the remaining sixty pigs has been completed in two groups, one of twenty, and another of forty. In this final report these groups will be referred to as I, II and III respectively.

The experiment with Group II, consisting of twenty pigs, began in August, 1935. The conditions and treatment were precisely the same as in the case of Group I, a full description of which was given in the interim report already referred to; the only difference was in the time of year when the experiment was carried out, the experiment with Group I having begun in February. The original intention was that this second group should consist of twenty pairs. Forty fine healthy weaners, having an average weight of 36½ lb. at eight weeks old, were selected. They compared very favourably with the pigs of the first group. Soon after the experiment began, however, many of the pigs became infected with some form of scour, and even after they got over the attack several remained unthrifty and were often off their feed. The cause of the trouble was never discovered but, as it occurred before differential feeding began, it cannot be ascribed to the experimental treatment. It was therefore decided that some of these pigs were unsuitable material for further experimental work, and in consequence twenty pigs were discarded and the group reduced to ten pairs only. Even after this had been done, however, the result was not completely satisfactory, for periodically some of the pigs went off their feed. Where this occurred with an unrestricted pig, the terms of our experiment necessitated the reduction of the amount fed to its restricted mate, which in consequence got an unduly restricted ration. This difficulty led us to make a modification in the feeding of the third group which will be discussed later.

The marked differences in conformation between restricted and unrestricted pigs, which had been so striking a feature in Group I, were not reproduced in anything like the same degree in Group II.

1. *Age at Bacon Weight and Rate of Gain.*

As with Group I so with Group II, in each case the unrestricted pig reached bacon weight some considerable time before its fellow, the difference varying from 21 to 49 days, with an average of 34 days. This compared with a difference of from 7 to 49 days, and an average of 27¼ days, with Group I. The average ages at which the restricted and unrestricted pigs in Group II reached bacon weight were 171½ and 208 days respectively. These compare very favourably with the corresponding figures for Group I (190 and 217 days), the difference being due, no doubt, to the greater average weight of Group II at eight weeks old. As already explained, Group II were undoubtedly a much better bunch of weaners than Group I. The average daily live-weight gain was 1·57 lb. for the unrestricted pigs as opposed to 1·18 lb. for the restricted pigs. These figures are almost exactly the same as with Group I (1·55 lb. and 1·19 lb. respectively).

TABLE I (GROUP II).

Pair No.	Unrestricted Pigs.			Restricted Pigs.		
	No. of Pig.	Age at Bacon Weight.	Rate of L.-W. gain per day.	No. of Pig.	Age at Bacon Weight.	Rate of L.-W. gain per day.
		days.	lb.		days.	lb.
1 . .	1269	165	1·70	1265	214	1·15
2 . .	1266	200	1·26	1272	221	1·08
3 . .	1264	186	1·40	1268	214	1·15
4 . .	1262	165	1·58	1271	214	1·13
5 . .	1250	172	1·64	1247	221	1·14
6 . .	1308	145	1·83	1305	187	1·32
7 . .	1309	159	1·76	1311	194	1·28
8 . .	1397	179	1·37	1391	200	1·25
9 . .	1396	179	1·37	1398	207	1·14
10 . .	1394	165	1·75	1390	207	1·20
Mean .		171·5	1·57		207·9	1·18

2. *Food Consumption.*

As with Group I the average food consumption from weaning to bacon weight was less in the case of the restricted pigs than in that of the unrestricted, the figures being 707 lb. and 722 lb. respectively. This difference was not nearly so marked as in Group I, where the figures were 554 and 635. The average daily consumption of food by the unrestricted pigs was 6·27 lb., whereas the restricted pigs averaged 4·68 lb. per day. No doubt the difference in the amount of food consumed by the two groups was largely due to the time of year, Group I being fed between February and August and Group II between August and

December. The unrestricted pigs consumed 4·07 lb. of food per pound of live-weight gain and the restricted 3·96 lb. The comparable figures for the first group were 3·60 and 3·28 lb. respectively. The percentage of carcase weight to fed live weight was slightly greater for the restricted pigs than for the unrestricted pigs, as is indicated by the figures for the amount of food consumed per pound dead-weight gain. (As with Group I the initial dead weight was calculated as being two-thirds of the initial live weight.) These figures were 5·39 lb. for the unrestricted pigs and 5·26 lb. for the restricted, compared with 4·91 lb. and 4·53 lb. respectively for Group I.

TABLE II (GROUP II).

Pair No.	Unrestricted Pigs. No. of Pig.	Food Consumption.	Average food consumption per day	Food consumption per lb. L.-W. gain.	Food consumption per lb. dead-weight gain.	Restricted Pigs. No. of Pig.	Food Consumption.	Average food consumption per day.	Food consumption per lb. L.-W. gain.	Food consumption per lb. dead-weight gain.
1	1269	660·5	6·06	3·56	4·93	1265	725	4·59	4·01	5·29
2	1266	945	6·56	5·22	6·65	1272	768	4·65	4·31	5·65
3	1264	804	6·18	4·41	5·70	1268	699·5	4·43	3·85	5·14
4	1262	667	6·12	3·88	5·17	1271	721	4·56	4·05	5·34
5	1250	650	5·96	3·64	4·88	1247	727	4·60	4·05	5·64
6	1308	576	6·47	3·53	4·76	1305	651	4·97	3·76	5·05
7	1309	695	6·75	3·83	5·15	1311	678·5	4·91	3·86	5·03
8	1397	793	6·40	4·66	6·05	1391	692	4·77	3·82	4·91
9	1396	775·5	6·25	4·58	6·01	1398	707	4·65	4·06	5·48
10	1394	656·5	5·97	3·42	4·59	1390	704	4·63	3·85	5·10
Mean		722·3	6·27	4·07	5·39		707·3	4·68	3·96	5·26

Reckoned on a live-weight basis the efficiency of the restricted pigs was greater in only four cases out of ten and on a dead-weight basis in five out of ten. The total difference in efficiency in favour of the restricted pigs was slight, and was quite insignificant statistically.

3. *Grading.*

Tables III and IV show that, as with the first group, the restricted pigs graded distinctly better than the unrestricted. Only 10 per cent. of the unrestricted pigs were in the bonus grades A and B as compared with 60 per cent. of the restricted pigs. The comparable figures for the first group were 10 per cent. and 55 per cent. respectively. In only one case did the unrestricted pig of a pair grade better than its restricted fellow. It should be noted that the general level of grading of the pigs in Group II was rather higher than that in Group I. In both cases 80 per cent. of the unrestricted pigs graded C or D, but in Group II 70 per cent. were in Grade C and only 10 per cent in Grade D, whereas in Grade I 25 per cent. were in Grade C and

TABLE III (GROUP II).

Pair No.	Unrestricted Pigs.				Restricted Pigs.			
	No. of Pig.	Back.	Streak.	Pay-ment.	No. of Pig.	Back.	Streak.	Pay-ment.
1 . .	1269	C	B	C	1265	B	A	B
2 . .	1266	C	A	C	1272	A	A	A
3 . .	1264	C	A	C	1268	C	A	C
4 . .	1262	D	A	D	1271	A	A	A
5 . .	1250	C	C	C	1247	B	B	B
6 . .	1308	C	C	C	1305	A	A	A
7 . .	1309	E	A	E	1311	D	A	D
8 . .	1397	A	A	A	1391	C	A	C
9 . .	1396	C	A	C	1398	B	A	B
10 . .	1394	C	A	C	1390	C	A	C

TABLE IV (GROUP II).

Grading.	Unrestricted Pigs.				Restricted Pigs.			
	No. of Pigs.	As % of Total.	No. of Hogs.	No. of Gilts.	No. of Pigs.	As % of Total.	No. of Hogs.	No. of Gilts.
A . .	1	10	—	1	3	30	2	1
B . .	—	—	—	—	3	30	2	1
C . .	7	70	4	3	3	30	1	2
D . .	1	10	1	—	1	10	—	1
E .	1	10	1	—	—	—	—	—

55 in Grade D. Table IV shows that gilts graded better than hogs as was the case with the first group.

4. *Efficiency of Production by Pigs of Different Grades.*

TABLE V (GROUP II).

Grading.	Unrestricted Pigs.				Restricted Pigs.			
	No. of Pigs.	Average age in days.	Average food consumption per lb. L.-W. gain.	Average food consumption per lb. D.-W. gain.	No. of Pigs.	Average age in days.	Average food consumption per lb. L.-W. gain.	Average food consumption per lb. D.-W. gain.
A . .	1	179	4·66	6·05	3	207·3	4·04	5·35
B . .	—	—	—	—	3	214	4·04	5·47
C . .	7	173	4·05	5·36	3	207	3·84	5·03
D . .	1	165	3·88	5·17	1	194	3·86	5·03
E . .	1	159	3·83	5·15	—	—	—	—

A distinct tendency for lower grade pigs to reach bacon weight in a shorter time, and to have a greater efficiency in converting food into meat, than higher grade pigs, is shown in Table V. This tendency was more marked than in Group I.

5. *The Financial Aspect.*

The restricted pigs consumed 0·12 lb. of meal less per pound of carcase than the unrestricted pigs, and the average increase in price per score, due to better grading, was 0·45*s*. In Group I the figures were 0·38 lb. and 0·65*s*. respectively. Taking a final carcase weight of 150 lb., the saving in food is 15·6 lb. per pig, which, if valued at 8*s*. per cwt. (as in the first trial) represents a saving of 1*s*. 1*d*. per pig. The better grading represents an increased return of 2*s*. 11*d*. per pig. The total financial advantage as calculated in this way would therefore be 4*s*. per pig, against which must be set the increased charges for labour and accommodation for the extra time taken by the restricted pigs. With this group the extra time was thirty-six days.

It is clear from the data that have been given that the benefits of restricted feeding, though still in evidence with this groups of pigs, were not nearly so marked as with Group I.

Group III.

The trial with Group III, consisting of forty pigs, began in June, 1936, under the same conditions as the two previous trials. A slight alteration, however, was made in the method of deciding the amounts of food to be fed to the restricted pigs. It will be remembered that in Group II some of the pigs received an abnormally restricted diet because their rations were related to those of the unrestricted pigs, and when these latter were off their food the amount fed to the restricted pigs had to be cut down below what was intended. To avoid this happening again it was decided to fix the rations of the restricted pigs according to their live weights, on the basis of the amounts that the restricted pigs in Group I had received when no abnormalities had occurred. The composition of the ration was the same as in the two previous experimental periods. The following table shows the amount fed to the restricted pigs at varying live weights.

Live Weight (lb.).	Amount of Food consumed per week (lb.).
60—69	21
70—79	22
80—89	23½
90—99	25½
100—109	25
110—119	27
120—129	30
130—139	31
140—149	32½
150—159	33
160—169	34
170—179	35
180—189	36½
190—	37½

Group III consisted of twenty pairs of exceptionally good weaners, and after the unsatisfactory behaviour of the pigs in Group II, it was pleasing to see this group get away well from weaning, and thrive in a manner comparable to those in Group I. Restriction of feeding began at 60 lb. live weight, and by the time the unrestricted pigs had reached 120 lb. live weight, it was easy to distinguish them from the others by their heavy shoulders and jowls. As they neared bacon weight the difference in type became more apparent, and though perhaps it was not so marked as with Group I it was, nevertheless, very definite.

1. *Age at Bacon Weight and Rate of Gain.*

TABLE VI (GROUP III).

Pair No.	Unrestricted Pigs.			Restricted Pigs.		
	No. of Pig.	Age at Bacon Weight.	Rate of L.-W. gain per day.	No. of Pig.	Age at Bacon Weight.	Rate of L.-W. gain per day.
		days.	lb.		days.	lb.
1	1672	173	1·43	1670	208	1·10
2	1665	152	1·73	1667	194	1·14
3	1671	166	1·47	1663	201	1·16
4	1668	159	1·55	1664	201	1·08
5	1703	170	1·35	1706	212	1·04
6	1707	163	1·55	1705	226	1·03
7	1696	164	1·57	1695	206	1·06
8	1693	178	1·33	1694	213	1·06
9	1687	171	1·44	1682	213	1·06
10	1680	178	1·32	1681	213	1·08
11	1704	177	1·36	1709	212	1·04
12	1735	151	1·61	1733	193	1·14
13	1685	178	1·44	1686	199	1·16
14	1719	161	1·52	1713	210	1·10
15	1732	158	1·63	1729	200	1·11
16	1717	168	1·55	1715	210	1·09
17	1725	167	1·55	1722	216	0·99
18	1723	153	1·61	1721	209	1·07
19	1724	153	1·68	1727	195	1·19
20	1728	167	1·49	1720	216	1·00
Mean		165·4	1·51		207·4	1·09

The pigs in Group III were an exceptionally good lot, the average weight at eight weeks being just under 40 lb. They put on weight rapidly, and the unrestricted pigs reached an average live weight of 203 lb. when their average age was only 165 days. The restricted pigs took 42 days longer to reach the same weight, but even in their case the age at bacon weight must be considered good. Their time, 207 days, might have been considerably reduced but for the fact that restriction of feeding brought the finishing period of nineteen of the restricted pigs

into the months of November and December, whereas the unrestricted pigs reached bacon weight in the more congenial months of September and October, the last one going to the factory on October 20th. It will be noticed that the unrestricted pigs in Groups II and III reached bacon weight in a much shorter time than those in Group I, due probably to the fact that they were much heavier at weaning.

2. *Food Consumption.*

The figures in Table VII show a similar efficiency in terms of food consumed per pound live-weight increase for both restricted and unrestricted pigs, but a considerable difference in terms of food consumed per pound dead-weight increase, the advantage being with the restricted pigs. The percentage of dead weight to fed live weight was 73·5 for the unrestricted pigs and 75·1 for the restricted, and this explains the difference in efficiency in

TABLE VII (GROUP III).

	Unrestricted Pigs.					Restricted Pigs.				
Pair No.	No. of Pig.	Food Consumption.	Average Food Consumption per day.	Food consumption per lb. L-W. gain.	Food consumption per lb. dead weight gain.	No. of Pig.	Food Consumption.	Average Food Consumption per day.	Food Consumption per lb. L-W. gain.	Food Consumption per lb. dead weight gain.
1 . .	1672	634	5·47	3·83	5·31	1670	593	3·93	3·58	4·80
2 . .	1665	500	5·26	3·06	4·05	1667	558	4·07	3·58	4·57
3 . .	1671	595	5·46	3·72	4·98	1663	573·5	3·98	3·43	4·45
4 . .	1668	556·5	5·46	3·52	4·64	1664	563	3·91	3·63	4·67
5 . .	1703	675·5	5·82	4·30	5·65	1706	632	4·00	3·83	4·94
6 . .	1707	602·5	5·53	3·56	4·90	1705	632·5	3·68	3·44	4·76
7 . .	1696	588·5	5·40	3·44	4·65	1695	578·5	3·83	3·60	4·67
8 . .	1693	675·5	5·57	4·10	5·47	1694	617·5	3·91	3·68	4·98
9 . .	1687	617·5	5·32	3·70	5·02	1682	608·5	3·85	3·63	4·58
10 . .	1680	660	5·37	4·07	5·26	1681	616	3·90	3·61	4·65
11 . .	1704	648	5·27	3·88	5·27	1709	614	3·89	3·73	5·16
12 . .	1735	526	5·54	3·44	4·72	1733	542·5	3·96	3·48	4·60
13 . .	1685	654	5·32	3·70	4·97	1686	546	3·79	3·27	4·33
14 . .	1719	527·5	4·98	3·27	4·43	1713	600	3·86	3·52	4·48
15 . .	1732	561·5	5·50	3·38	4·64	1729	569	3·95	3·56	4·66
16 . .	1717	598	5·29	3·42	4·64	1715	577·5	3·73	3·41	4·41
17 . .	1725	644	5·91	3·82	5·03	1722	648·5	4·10	4·16	5·50
18 . .	1723	543·5	5·72	3·55	4·79	1721	625	4·14	3·87	4·96
19 . .	1724	544	5·73	3·41	4·63	1727	563	4·11	3·44	4·73
20 . .	1728	674·5	6·19	4·15	5·46	1720	648·5	4·10	4·08	5·34
Mean .		601·3	5·51	3·67	4·93		595·3	3·93	3·63	4·70

terms of dead-weight gain, compared with live-weight gain. In twelve out of the twenty pairs the efficiency of the restricted pigs was greater, reckoned on a dead-weight basis, than that of the unrestricted pigs, while in only two cases was the efficiency of the unrestricted pigs to any extent greater than that of the restricted. There was no significant difference in efficiency between sexes.

3. *Grading.*

Tables VIII and IX show that the grading of the restricted pigs, based on the thickness of back fat and streak, was very much better than that of the unrestricted pigs, 80 per cent. being in the bonus grades A and B, compared with 30 per cent. of the unrestricted pigs. Gilts again graded better than hogs.

TABLE VIII (GROUP III).

Pair No.	Unrestricted Pigs.				Restricted Pigs.			
	No. of Pig.	Back.	Streak.	Payment.	No. of Pig.	Back.	Streak.	Payment.
1	1672	A	A	A	1670	A	A	A
2	1665	D	B	D	1667	B	C	C
3	1671	B	A	B	1663	A	A	A
4	1668	D	B	D	1664	B	A	B
5	1703	C	A	C	1706	A	A	A (*s*)
6	1707	D	B	D	1705	A	A	A (*s*)
7	1696	D	B	D	1695	A	A	A
8	1693	B	A	B	1694	A	C	C (*s*)
9	1687	B	B	B	1682	A	B	B (*s*)
10	1680	A	A	A	1681	A	B	B (*s*)
11	1704	D	A	D	1709	A	B	B (*s*)
12	1735	C	C	C	1733	A	A	A (*s*)
13	1685	C	A	C	1686	A	A	A
14	1719	B	A	B	1713	A	A	A (*s*)
15	1732	C	B	C	1729	C	A	C (*s*)
16	1717	C	A	C	1715	A	A	A (*s*)
17	1725	C	A	C	1722	B	A	B (*s*)
18	1723	C	B	C	1721	C	A	C (*s*)
19	1724	C	A	C	1727	A	A	A (*s*)
20	1728	C	A	C	1720	B	A	B (*s*)

(*s*) = Soft fat.

TABLE IX (GROUP III).

Grading.	Unrestricted Pigs.				Restricted Pigs.			
	No. of Pigs.	As % of Total.	No. of Hogs.	No. of Gilts.	No. of Pigs.	As % of Total.	No. of Hogs.	No. of Gilts.
A	2	10	2	—	10	50	6	4
B	4	20	1	3	6	30	5	1
C	9	45	6	3	4	20	3	1
D	5	25	5	—	—	—	—	—
E	—	—	—	—	—	—	—	—

The quality of the fat was, however, better in the unrestricted group. The last fourteen restricted pigs, which went to the factory from November 17th to December 8th, had soft fat, and a lower price was received for them. These "soft" pigs are not usually graded, but in this case the back and streak measurements were taken for purposes of comparison with the unrestricted

pigs. It is not easy to explain why these last fourteen pigs should have had softer fat than the others, considering that the ration was never changed. Experiments on the effect of rate of growth on the quality of the fat have, however, shown that a slow rate of growth results in a softer fat than a quick rate, and it seems probable that during the last weeks of the experiment, restriction of feeding (at possibly too low a level), coupled with the cold wet conditions, made the rate of growth slow enough to produce fat which would not set. If this theory is correct it would appear to indicate that in this case restriction of feeding had been carried too far and that, although the same level of feeding had not produced soft fat during the summer months of the first experimental period, the increased requirements for maintenance during the winter months brought about a decrease in the rate of growth sufficient to affect the texture of the fat.

It is fairly safe to conclude from these results that whereas 5½ lb. per day may be an adequate allowance for a bacon pig during the last stages of growth in summer, it is not enough in winter unless the building in which the pig is kept is of such a character that the pig can be kept reasonably warm and dry. In this particular case, the accommodation being (as has already been explained) an old sheep yard, these conditions were not fulfilled.

4. *Efficiency of Production by Pigs of Different Grades.*

The figures in Table X show a definite tendency towards increased efficiency of production in the lower grades of the unrestricted pigs, both in terms of weight for age and in the amount of food consumed per pound dead-weight gain. This tendency is not to be seen in the case of the restricted pigs; nor would it be expected, the natural efficiency of these pigs being altered by restriction of feeding.

TABLE X (GROUP III).

Grading.	Unrestricted Pigs.				Restricted Pigs.			
	No. of Pigs.	Average age in days.	Average food consumption per lb.		No. of Pigs.	Average age in days.	Average food consumption per lb.	
			L.-W. gain.	D.-W. gain.			L.-W. gain.	D.-W. gain.
A . .	2	175·5	3·95	5·29	10	206	3·50	4·62
B . .	4	169	3·70	4·98	6	211·8	3·81	4·98
C . .	9	162·8	3·69	4·95	4	204	3·67	4·79
D . .	5	163	3·49	4·70	—	—	—	—
E. . .	—	—	—	—	—	—	—	—

5. *Financial Advantage.*

The restricted pigs consumed 0·17 lb. of meal less per pound dead-weight gain than the unrestricted pigs and they were worth 0·58 shillings more per score, based on their back and belly measurements. Taking a final carcase weight of 150 lb. and an initial carcase weight of 20 lb., the smaller amount of food consumed by the restricted pigs represents a saving of 22·1 lb. per pig and this, at £8 per ton, is worth 1*s.* 7*d.* The better grading represents an increased return of 3*s.* 9*d.* per pig, making the total financial advantage 5*s.* 4*d.*, against which must be set the increased charges for labour, etc., for the extra forty-two days taken by the restricted pigs. Actually the financial advantage of restricted feeding with this group was reduced by the occurrence of soft fat.

TOTALS OF GROUPS I, II AND III.

Having considered the three groups separately we may now pass to a consideration of the total results obtained by averaging the figures relating to all groups together.

1. *Age at Bacon Weight and Rate of Gain.*

TABLE XI (TOTALS OF GROUPS I, II AND III).

	Average age at Bacon Weight.	Average Rate of L.-W. gain.	Average Rate of D.-W. gain.
	days.	lb.	lb.
50 Unrestricted Pigs	176·3	1·54	1·16
50 Restricted Pigs	211·4	1·15	0·87

These figures show clearly that restriction of feeding slowed down the rate of live- and dead-weight gain considerably, the average difference in age at bacon weight being 35 days. The figures for Groups I, II and III, were 27¼ days 36½ days, and 43 days respectively. The age at bacon weight of the unrestricted pigs must be regarded as very good and that of the restricted pigs as quite up to average. The unrestricted hogs reached bacon weight earlier than the unrestricted gilts, but there was no difference between the sexes in this respect when restricted. The difference between the relative behaviour of sexes in the restricted and unrestricted groups was statistically significant at the 1 per cent. point.

The unrestricted gilts made a smaller daily live-weight increase than the unrestricted hogs; this position was reversed with the restricted pigs.

2. *Food Consumption.*

TABLE XII (TOTALS OF GROUPS I, II AND III).

	Food consumption.	Average Food consumed per day.	Food consumption per lb.	
			L.-W. gain.	D.-W. gain.
	lb.	lb.		
50 Unrestricted Pigs . . .	639·14	5·68	3·72	5·01
50 Restricted Pigs . . .	601·29	4·08	3·56	4·76

The efficiency of the restricted pigs, both in terms of food consumed per pound live-weight gain and per pound dead-weight gain was, on the average, considerably better than that of the unrestricted pigs. The greatest difference between the efficiency of the restricted and unrestricted pigs occurred in Group I, when the difference was 0·32 lb. of food consumed per pound live-weight gain, and 0·38 lb. of food consumed per pound dead-weight gain. The difference was slight in Groups II and III, but what difference there was tended to favour the restricted pigs.

For the hundred pigs taken together, this difference in efficiency in favour of the restricted pigs, based on food consumed per pound live-weight gain, is statistically significant at the 1 per cent. point, and based on food consumed per pound dead-weight gain, significant at the 0·1 per cent. point.

Statistical analysis of the figures reveals an additional point of interest. The "efficiency" of the unrestricted gilts was not so great as that of the unrestricted hogs; on the other hand the restricted gilts were more efficient than the restricted hogs. This interaction was significant at the 1 per cent. point.

The theoretical explanation of this is probably that the hog (castrated male) has a higher potentiality for adding fat to the carcase, and when the ration is unrestricted it can make more use of it than the female. This is seen in the shorter time which the unrestricted hogs took to reach bacon weight and in their lower grading results due to thicker back fat. On a restricted ration this greater capability of the hogs to lay on fat cannot be utilized owing to lack of food. In other species of animals (sheep) it has been found that on a low plane of nutrition the female suffers less than the male, *i.e.*, it has a more economical metabolism.

3. *Grading.*

The figures in this table present a very striking picture of the influence of restricted feeding upon the grading of the carcase. No fewer than 66 per cent. of the restricted pigs come within

TABLE XIII (TOTALS OF GROUPS I, II AND III).

Grading.	Unrestricted Pigs. No. of Pigs.	As % of Total.	No. of Hogs.	No. of Gilts.	Restricted Pigs. No. of Pigs.	As % of Total.	No. of Hogs.	No. of Gilts.
A . .	3	6	2	1	20	40	9	11
B . .	6	12	1	5	13	26	9	4
C . .	21	42	13	8	12	24	8	4
D . .	17	34	12	5	4	8	3	1
E . .	3	6	2	1	1	2	1	—

the bonus grades compared with only 18 per cent. of the unrestricted pigs. In the lowest Grades (D and E) there are only 10 per cent. of the restricted pigs as against 40 per cent. of the unrestricted. The factor which determined the grading was in nearly every case the thickness of the back fat.

The influence of restricted feeding on the thickness of back fat is statistically significant at the 0·1 per cent. point, and is insignificant as regards its influence on the thickness of the belly. Although the restricted pigs appeared longer, yet in fact they were not; the average length of the carcases of the restricted pigs being 77·83 cm., and that of the unrestricted being 77·60 cm. This difference is statistically quite insignificant.

The superior grading of the gilts as opposed to the hogs is statistically significant.

4. *Efficiency of Production by Pigs of Different Grades.*

TABLE XIV. (TOTALS OF GROUPS I, II AND III).

Grading.	Unrestricted Pigs. No. of Pigs.	Average age in days.	Average food consumed per lb. L.-W. gain.	Average food consumed per lb. D.-W. gain.	Restricted Pigs. No. of Pigs.	Average age in days.	Average food consumed per lb. L.-W. gain.	Average food consumed per lb. D.-W. gain.
A . .	3	177	4·19	5·54	20	211·1	3·50	4·64
B . .	6	178	3·73	5·03	13	214·4	3·72	4·93
C . .	21	171·2	3·74	5·02	12	210·8	3·58	4·68
D . .	17	181·7	3·59	4·88	4	207·5	3·43	4·53
E . .	3	179·3	3·79	5·13	1	203·0	3·16	4·18

The figures for the fifty unrestricted pigs in Table XIV show a marked tendency for the pigs in the lower grades to have a higher "efficiency" than those in the higher grades. This is substantiated by the fact that the correlation between "efficiency," as measured by the amount of food consumed per pound dead-weight gain, and thickness of back fat is negative, and statistically significant at the 1 per cent. point. In other

words pigs with a high "efficiency" tend to have thicker back fat than pigs with a low "efficiency." The tendency is probably due to less food being required for maintenance in the quickly-growing pig While on theoretical considerations the food required to produce a pound of fat is more than that required to produce a pound of lean, it is evident that the smaller amount of food required for maintenance in the quick-growing pig outweighs this.

For the restricted group this correlation is reversed; pigs with a high "efficiency" tending to have thinner back fat than those with a low "efficiency." The theoretical explanation for this is probably similar to that suggested for sex differences in efficiency on the two planes of nutrition (see page 182).

5. *Financial Advantage.*

Using the same calculations as with the individual groups, the restricted pigs, taken together, consumed 33 lb. of meal per head less than the unrestricted pigs, and this at £8 per ton represents a saving of 2*s*. 4½*d*. per pig. Similarly, the increased price per pig due to better grading is 3*s*. 9*d*. and the total increased return for the restricted pigs is 6*s*. 1½*d*., against which must be set charges for labour, etc., for the extra thirty-five days which they had to be kept.

CONCLUSIONS.

As a result of this experiment certain definite conclusions emerge.

1. Restricted as opposed to unrestricted feeding definitely improves the quality of the carcase as determined by the thickness of the back fat, and at the same time has no ill effect on the thickness of the belly.

2. Restricted feeding not only does not impair the "efficiency" of the pigs, but has a definite tendency to improve it. Thus, though the 100 restricted pigs were thirty-five days older at slaughter they had actually consumed 33 lb. less food per head during the course of their lives.

3. The optimum level of feeding has not been definitely determined. There is no doubt that it is in some measure dependent upon the time of year, and also upon the type of pig involved. It appears from 1 and 2 above, that restriction is beneficial in two ways, firstly by preventing the pig from putting on an undue amount of back fat, and secondly by reducing the quantity eaten to a level that the pig can economically digest and convert into meat. The optimum appears to be in the neighbourhood of three-quarters of the quantity that the pig would consume if given as much as it will eat.

4. If restriction is carried too far the rate of live-weight

gain is reduced to such a level that the quality of the fat is adversely affected and there is a risk of "soft" fat being produced.

5. With unrestricted feeding there is a definite correlation between "efficiency" and thickness of back fat, the correlation being negative. In other words the lower grade pigs are rather more efficient than those of the top grades. Under conditions of restricted feeding, however, the position is reversed and the pigs in the higher grades are rather more efficient than those in the lower. No definite figures on this point have ever been available before, and it was due to the planning of the experiment, in which each pig was fed individually, that they are now for the first time available. This conclusion seems very important for it emphasizes the dangers which attach to the selection of breeding stock on a basis of grading results, without at the same time checking up "efficiency."

Some practical feeders have objected that while restricted feeding may give good results when pigs are fed individually, as in this experiment, the benefits cannot be obtained in practice when the pigs are fed in groups. This, however, need not be the case provided that certain conditions (conditions that are not abnormal in practice already) are fulfilled. The conditions are as follows. The pigs should be in pens of not more than a dozen. They should be reasonably uniform in size. There should be adequate trough room. It should be possible to exclude the pigs from the troughs until all the food has been put in. If these conditions are fulfilled every pig has an equal chance of getting its proper ration. If these conditions are not fulfilled then the stronger pigs will get considerably more than their weaker brethren.

The authors would like again to emphasize the fact that these results have been obtained by using exclusively Large White pigs from the Cambridge University Farm herd. A description of the type of pig in the herd was given in the interim report.

The authors wish to take this opportunity of thanking Dr. Callow of the Low Temperature Research Institute for his work in measuring the carcases at the Bacon Factory, the Elmswell Bacon Factory for the facilities which they provided for doing this, and Messrs. Garner and Sanders for their assistance with the statistics. Finally they would again like to express their gratitude to the Research Committee of the Royal Agricultural Society for a grant which made the experiment possible.

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THE REPLACEMENT OF MANGOLDS BY WET SUGAR BEET PULP IN THE RATIONS OF FATTENING BULLOCKS.

The establishment of the sugar beet industry in this country has resulted in a large reduction in the area of land under mangolds, with a corresponding decrease in the quantity of roots available for stock feeding. The by-products from the sugar beet industry have, in part, replaced mangolds and swedes for bullock feeding; the bullocks receiving the tops in the yards and the pulp being fed in the wet or dry condition.

Wet pulp can be fed right through the fattening period from October to April—as fresh pulp until the end of the factory campaign, and afterwards as clamped pulp until the supply is exhausted. Wet pulp is most likely to be economical as cattle food on those farms in the vicinity of a factory, as haulage costs are considerable and may make the price prohibitive on the more remotely situated farms; but the possibilities of a return load of pulp from the factory, in the lorries that deliver the beet, may reduce transport charges.

During the lifting season it is usually impossible to utilize the whole of the wet pulp supply immediately it is received from the factory, and some method of storing has to be adopted. Wet pulp that is required for feeding within a fortnight can be stored successfully in the turnip house attached to the bullock yard, or in a bay of a barn. Under these circumstances it is advisable to have a well-drained site for the pulp heap, so that the lower layers of the pulp shall not hold the water that falls through from the overlying layers. This method of storing is not suitable for pulp that has to be kept for several months because considerable wastage, due to the development of moulds, occurs in wet pulp that is left in contact with the air for any length of time.

At the Norfolk Agricultural Station the wet pulp that is not required for immediate use is clamped on delivery from the factory. In general, the method employed is to select a well-drained site near the farm buildings, so that the cost of carting into the yards may be reduced to a minimum; the site should also be close to a road so that, if the state of the land will not allow the vehicle bringing the pulp to go on the field, the pulp can be unloaded from the road and thrown over the fence on to the clamp. The pulp is put into a compact prism-shaped mass, the base of the clamp being 7 feet wide and the height, before

any settling has taken place, from 4 to 5 feet. With these dimensions, 1 yard length of the clamp will hold approximately 1 ton of wet pulp. The clamp is covered with a layer of soil from 4 to 6 inches thick. The heap settles considerably during the first few days and excess water must be allowed to drain away if decay of the lower layers of the clamp is to be prevented. In this condition the pulp can be stored for several months without much wastage due to rotting. When opened, the layer of soil can be easily pared off, and the pulp, which is now a greyish white mass, is readily eaten by cattle.

The Composition of Wet Pulp.

An approximate idea of the relative feeding values of wet pulp and mangolds is obtained from the composition of the dry matter of these two foods. The most striking difference between wet pulp and mangolds is the higher fibre content of the pulp. Ninety per cent. of the fibre is, however, digestible, and therefore the feeding value is not adversely affected. Wet beet pulp has a higher protein content than mangolds, but the difference is small and probably does not add appreciably to its feeding value. When the moisture contents of the two feeds are taken into consideration, wet beet pulp has a higher feeding value than mangolds, as is shown by the following analyses from *Rations for Live Stock* (Ref. 1) :—

	Dry Matter per cent.	Starch Equivalent.	Protein Equivalent.
Wet Beet Pulp . .	15·0	11·7	1·0
Mangolds . . .	12·0	6·2	0·4

On analysis, therefore, 1 ton of wet pulp containing 15 per cent. dry matter is equivalent in feeding value to 1·9 tons of mangolds with 12 per cent. dry matter, when compared on a starch equivalent basis. The replacement of mangolds by wet pulp, however, cannot be done on this basis owing to the variations in the dry-matter contents of both mangolds and wet pulp. In the above analyses, wet pulp is given a dry-matter content of 15 per cent., but actually material with so high a percentage is not always obtainable, whereas a dry-matter content of 12 per cent. for mangolds is quite common. Therefore, in general farm practice, 1 ton of wet pulp would replace rather less than 1·9 tons of mangolds.

Trials with Wet Pulp.

Much criticism has been offered against wet pulp as a food for fattening bullocks, chiefly by butchers, who claim that pulp-fed animals kill badly and that their meat "eats dry." To test the validity of these criticisms, and also to find out to what extent wet pulp can be relied upon to replace mangolds in the rations

of yard-fed bullocks, a series of trials were carried out at the Norfolk Agricultural Station from 1932 to 1934. The procedure in these trials was similar to that adopted for other bullock feeding trials, accounts of which have already been published (Ref. 2). Taking the trials together, the performance of 29 bullocks on wet beet pulp has been compared with that of 29 bullocks on mangolds. Usually the bullocks received fresh wet pulp until the end of the factory campaign, and after that clamped pulp. The supply of clamped pulp and mangolds was always exhausted before the bullocks were ready for market, so that both groups of bullocks were finished on dried beet pulp.

Some slight difficulty was usually experienced in getting the bullocks, when they were first brought into the yards, to eat sufficient wet pulp, and consequently before the beginning of each trial there was a preliminary feeding period during which the bullocks were allowed to become accustomed to the experimental rations. Some feeders have noticed that wet-pulp-fed bullocks tend to scour rather badly, but during the whole period of these trials no such trouble was experienced; this was probably because the bullocks were given a daily allowance of feeding chalk.

Each group of bullocks was given a common basal ration of straw, hay and concentrates. Throughout each trial the concentrate ration was gradually increased to compensate for the increasing weight of the bullocks, and at the end of the trial they were receiving from 6 to 8 lb. of cake and meal, consisting of 1½ to 2 lb. of cake and 4½ to 6 lb. of maize and other cereals. Linseed cake was not included in the rations.

In determining the quantities of wet pulp and mangolds to feed, it was assumed that the feeding value of these two foods varied in direct proportion to their dry-matter contents. The quantity of mangolds that the root-fed cattle would consume in a day was ascertained, and, by determining the dry-matter content of the mangolds, the feeding value of the roots ration was obtained. An amount of wet pulp, calculated to give the same feeding value as the mangolds, was fed to the pulp-fed bullocks. Minor adjustments of the two rations were sometimes necessary, because occasionally the pulp-fed bullocks could not consume all the wet pulp offered them. Frequent dry matter determinations were done on the wet pulp and mangolds, and the rations were altered weekly to allow for the slight variations in the dry-matter contents. The daily rations of wet pulp and of mangolds consequently varied from 60–90 lb. and from 90–130 lb. respectively. In each year the roots yard received a higher weight of dry matter, since the ratio of dry matter to starch

equivalent was higher in the mangolds than in the wet beet pulp. This is shown by the following tables :—

Weights of Nutrients (in lb.) of Rations at beginning of Trial.

	1932–33.		1933–34.		1934–35.	
	Roots.	Wet Pulp.	Roots.	Wet Pulp.	Roots.	Wet Pulp.
Dry matter (lb.) .	22·8	18·4	23·2	19·0	24·1	19·6
Starch equivalent (lb.)	11·6	11·8	12·3	12·2	12·1	12·0
Protein equivalent (lb.)	1·4	1·5	1·8	1·9	1·6	1·7

Weights of Nutrients (in lb.) of Rations at conclusion of Trial.

	1932–33.		1933–34.		1934–35.	
	Roots.	Clamped Pulp.	Roots.	Clamped Pulp.	Roots.	Clamped Pulp.
Dry matter (lb.) .	23·4	19·9	25·5	20·8	26·9	22·1
Starch equivalent (lb.)	12·4	12·8	14·0	13·8	14·3	14·3
Protein equivalent (lb.)	1·7	1·8	2·2	2·2	1·8	2·0

In spite of this difference between the dry-matter contents of the two rations, neither group of animals was ever restless, nor ever gave the impression that they were receiving insufficient food. The food values of the two rations were almost the same in each year. The greatest difference was in 1932–33, but here the discrepancy was only of the order of 3 per cent. The digestible protein is given as the "protein equivalent" because of the presence in the roots and pulp of "amides" or incompletely formed proteins.

It was very noticeable, in the 1932–33 and 1933–34 trials, that the bullocks consumed more wet pulp when it was a week old than when it was quite fresh, a point that is borne out by the following figures. :—

Average Consumption of Wet Pulp per head per day—lb.

No. of days after delivery .	1.	2.	3.	4.	5.	6.	7.	8.
Weight of wet pulp consumed, lb.	56	59	66	66	70	72	72	70

In 1932–33 an attempt was made to discover why there was this preference for pulp that had been standing in a heap for a few days. Whilst no definite conclusion could be reached, the results of this investigation suggested that the heating of the pulp in the heap, and the increase in the density of the pulp as it was allowed to stand, affected the consumption of wet pulp.

Results of the Trials.

During the winters 1932–33 and 1933–34 the trial periods were split into two parts, one in which fresh wet pulp was fed and the other when clamped pulp was used. In 1934–35 clamped pulp was fed for the whole of the trial period. In the following discussion no distinction is made between the fresh wet pulp and clamped pulp trial periods. This in no way affects the general

conclusions drawn from the trials, because the performance of the bullocks (except for a slight decrease in the live-weight gain during the actual change over from fresh to clamped pulp) was not affected by the substitution of the clamped pulp for the fresh wet pulp.

The trials were carried out with medium sized bullocks, the live-weight at the beginning of the trials varying from 8½ to 9½ cwt., and at the end from 10½ to 11 cwt. The live-weight gains, the number of days in the trials, and the average daily live-weight gains are given in the following table :—

	1932–33. Wet Pulp.	1932–33. Roots.	1933–34. Wet Pulp.	1933–34. Roots.	1934–35. Wet Pulp.	1934–35. Roots.
Average live-weight gain—lb.	243	269	180	210	133	130
No. of days in trial	126	126	113	113	59	59
Average live-weight gain per head per day	1·9	2·1	1·6	1·9	2·3	2·2

None of the differences in live-weight gains in the above table was statistically significant. If the results of the three trials be averaged it is found that the respective live-weight gains on wet pulp and mangolds were 1·9 and 2·1 lb. per head per day. The difference in the average gain of 0·2 lb. per head per day has a standard error of 0·15 lb. and is therefore not significant.

At the conclusion of the trials some of the bullocks were not "finished," and for the remainder of the fattening period dried sugar beet pulp was fed in place of the wet pulp and mangolds. As in the trial periods, there were no significant differences in the live-weight gains of the two groups of bullocks over the whole fattening period. The average daily live-weight gains over the whole period, *i.e.*, over the trial period and the succeeding "finishing" period, were 2 lb. (wet pulp and then dry pulp) and 2·2 lb. (roots and then dry pulp).

Neither was the quality of the finished animals adversely affected by the wet pulp feeding, as is shown by the following details of the sales :—

Trial.	No. of days to fatten.	Carcase percentage.	Price per cwt. live-weight. s.	d.
1932–33—				
Wet pulp	145	52·7	38	
Roots	144	53·9	38	
1933–34—				
Wet pulp	152	54·1	35	8
Roots	150	54·0	35	8
1934–35—				
Wet pulp	97	53·4	32	4
Roots	97	53·4	31	11

No importance can be attached to the very small differences in the carcase percentages. These percentages may be thought to be rather low, but this is because they were calculated not on

fasted live-weights but on the last farm weighing, which was taken before feeding on the morning of the day when the bullocks were sold. For the same reason the average price realized per live cwt. is smaller than it would have been had the fasted live-weight been used. Neither did the method of sale influence the comparison, for some of the bullocks from each group were sold privately on a dead-weight basis and the remainder on the open market. Thus there are no significant differences between the selling prices of the two groups of animals in either of the trials. On the average, the price per live cwt. of the pulp-fed bullocks was 3*d*. more than that of the root-fed beasts, but no significance can be attached to such a small difference.

Conclusions.—The results of these trials show that wet sugar beet pulp, both fresh and clamped, is a suitable substitute for mangolds in the rations of fattening bullocks. When the replacement is made after allowing for the difference in the dry-matter contents of the mangolds and the wet pulp, the live-weight gains of the bullocks are unaffected. None of the bullocks scoured whilst on the wet pulp, and it would appear that if bullocks are given a daily allowance of feeding chalk (in these trials 2 oz. per head daily were fed), no digestive disturbances should result. The quality of the carcases of the pulp-fed bullocks was equal to that of the bullocks receiving mangolds, and the butchers' report on the animals was to the effect that they were good quality beasts, there being no difference between the carcases of the bullocks from the two groups.

Thus 1 ton of wet sugar beet pulp, with a dry-matter content of 15 per cent. is, in practice as in theory, equivalent in feeding value to 1·9 tons of mangolds of 12 per cent. dry matter. As was pointed out earlier in this report, the dry-matter content of wet pulp may be as low as 10 per cent., in which case the quantity of mangolds with 12 per cent. dry matter required to replace 1 ton of wet beet pulp is approximately 1¼ tons. Wet beet pulp containing less than 10 per cent. of dry matter has been used in trials at the Norfolk Agricultural Station. From a practical farming point of view, it would be a great help if wet beet pulp could be bought with a guaranteed minimum dry-matter content. Not only would the farmer have some idea of the feeding value of the material he was purchasing, but he would also know that he was not paying freight on unnecessary water.

Financial Considerations.—From the above trials it has been concluded that wet pulp can replace mangolds in the rations of fattening bullocks, but the factor which will decide whether wet pulp or mangolds is the more economical to use will be the relative cost of fattening on these two foods. The cost of growing mangolds varies considerably from farm to farm;

Carslaw (Ref. 3) states that it varies from £12 13*s.* per acre on the lighter soils to £18 15*s.* on the heavier land. If an average figure of £15 per acre be taken for growing mangolds, and an average yield of 25 tons per acre be assumed, then the cost of 1 ton of mangolds in the clamp is 12*s.* The expenses connected with mangolds, however, do not terminate when the crop is harvested, but continue right through the winter months by the necessary carting from clamp to yard and the slicing before feeding. Fresh wet pulp, on the other hand, is carted straight to the yard, and the carrying of the pulp to the bullocks is the only further labour necessary. Consequently, it is found that the number of bullocks that a feeder can look after is greater when they are fed on wet pulp than when the ration includes mangolds. If a bullock takes 20 weeks to fatten and receives a daily allowance of 1 cwt. of mangolds, the total quantity of mangolds consumed per bullock is 7 tons at a cost of £4 4*s.* The weight of wet pulp, with 10 per cent. dry matter, that is equivalent to 7 tons of mangolds with 12 per cent. dry matter is 5·6 tons. It is impossible to put a general price on this weight of wet pulp because there are a number of variable factors, such as haulage costs and the amount of water in the pulp as it leaves the factory, to take into consideration. Fresh material would not be available for the whole of the fattening period, and clamped pulp would be necessary if pulp entirely replaced roots. The work involved in making the clamp, the subsequent carting of the pulp to the bullocks and losses in the clamp, all of which increase the cost of wet pulp feeding, make the valuation of pulp a difficult problem. But if the wet pulp actually fed to the bullocks, after allowing for all the items mentioned above, costs less than 15*s.* per ton, then it is cheaper than mangolds for fattening bullocks, if Carslaw's figures, as given above, can be applied generally.

Thus the comparison between wet pulp and mangolds must be made according to the proximity of the farm to the beet factory, and the other factors as they affect each particular case. These trials, however, suggest that, provided all the pulp could be used on farms within 15 miles of the beet factory, it would be to the farmers' advantage to buy wet pulp rather than to buy dry pulp or grow mangolds; although it is questionable whether this arrangement would suit the factories.

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Several members of the staff of the Norfolk Agricultural Station assisted in the conduct of these trails. Mr. E. T. Sykes, M.A., was responsible for the recording, and his assistance is gratefully acknowledged.

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References.

1. Rations for live stock. *Ministry of Agriculture and Fisheries, Bulletin* No. 48.

2. Rayns, F., M.A., and Sykes, E. T., M.A. Some results of fattening bullocks in open yards. *Journal of the R.A.S.E.*, **94**, 1933.

3. Carslaw, R. McG., M.A. Four years' farming in East Anglia 1923–1927. *University of Cambridge Department of Agriculture, Farm Economics Branch Report* No. 12.

THE FARMER'S GUIDE TO AGRICULTURAL RESEARCH IN 1936.

For the past twelve years the Royal Agricultural Society of England has issued annual summaries of Agricultural Research, as carried on in its leading branches, prepared under the direction of the Research Committee of the Society. The publication, originally issued under the title of *Agricultural Research*, is now known as *The Farmer's Guide to Agricultural Research*, for this describes the main purpose with which the Society undertook the work, namely, to spread the lessons of research among those to whom they are likely to be of greatest use by giving the farmer information on the results of the year's work of the experimental stations in a summarized and simple form.

The survey of scientific work which it provides is not limited to research conducted in the British Isles, but includes references to the results achieved in any part of the world from which light may be thrown on the problems of British agriculture.

As last year, *The Farmer's Guide* forms a section of the Society's *Journal* so that it may be in the hands of every member of the Society. At the same time a number of copies are being bound separately for distribution to the Press and to centres of Agricultural Education and Research.

The Authors responsible for the various sections are the same as those who contributed to the issue of the previous year.

A few copies of previous issues are still available.

CROPS AND PLANT BREEDING.

I.—GRASSLAND.

(a) The Improvement of Poor Pastures.

In the article on Crops and Plant Breeding published in the last issue of the *Farmer's Guide* (Ref. 1), a brief mention was made of some general considerations underlying the improvement of poor pastures. It is, therefore, particularly interesting that the first report of the preliminary investigations (1931–35) in connection with the Cahn Hill Improvement Scheme in Cardiganshire, has lately been published in a bulletin from Aberystwyth (Ref. 2). The bulletin deals particularly with the establishment and maintenance of palatable species and strains of herbage plants on

poor hill pastures, and also with the occurrence of buried but viable seeds in such areas.

The first article in the bulletin is by M. T. Thomas, who reviews the position in particular reference to the choice of species and strain; manurial treatment; establishment and cultivation; and after-management of the sown areas. The work was conducted at elevations between nine hundred and fifteen hundred feet on a vegetation which was originally dominated by *Molinia* (flying bent) or *Agrostis-Fescue*, with occasional and small areas of *Nardus* (mat grass), bracken and heather. The soils were of two main types—peaty soils which usually suffered from impeded drainage, and light, though often peaty, loams. Although these conditions are specially stated, the evidence may, in general, be said to apply equally to both types of soil and to all vegetation types studied in these experiments.

The conclusions reached are that the most important measures in the improving of poor hill grazings are (1) correct manuring, and (2) the sowing of superior species and strains of herbage plants, which are either absent from the sward or are present in amounts which are very much too small to give good pasturage. It was found impossible to establish seedlings from introduced seed without the addition of phosphates and lime, and even dressings as light as 1 cwt. of high-grade basic slag were beneficial. But in order to ensure the successful establishment and development of the seedlings of such plants as indigenous perennial ryegrass, pedigree cocksfoot, pedigree timothy, crested dogstail and wild white clover, considerably heavier and more complete dressings were necessary. These dressings were either applied initially or else were made up before the second year, and it was found that 10 cwt. of basic slag and 1 cwt. of nitro-chalk were really essential for proper sward development and to prevent early reversion to the poor herbage. In addition, heavy initial dressings of lime had a beneficial effect on the botanical composition in the fourth year, although the rate of growth was slower than on heavily slagged areas.

With regard to cultivations, better results in relation to initial establishment and growth were obtained after ploughing than after harrowing, while there was some evidence that a year's fallow would be best. But it is important to realize that the species did not all respond in the same way, even though there was little difference in the botanical composition, at the end of the four years, between areas which had been drastically harrowed and areas which had been ploughed. Light harrowing, and "hoof cultivation" by sheep, were not satisfactory. When cultivations were not practical it was found essential to lime a few years before sowing in order to help break down the mat of

undecayed vegetation before adding wild white clover and phosphate to continue the process.

But questions of management cannot really be considered without reference to the species, because the two are closely associated. Wild white clover was found to be the key species in the improvement work because of the part it plays in helping to break down the mat, and because of its protein and calcium efficiency. It is well known that abundant phosphate, freedom from shading, and good consolidation are essential to the successful establishment and growth of this species, and in the work under review it was found impossible to replace this species by wild red clover, or by the two species of birdsfoot trefoil—*Lotus corniculatus* and *L. major*.

Several grass species were tested and each had some application. Yorkshire fog, although it did not persist from commercial seed when heavily grazed and prevented from seeding, was extremely useful as a nurse crop to the other species because of its rapid growth after sowing. On account of this valuable character, and also because it holds the stock on the pastures, it is advisable to include this species in mixtures; but it must not be allowed to grow away from the stock and become unpalatable, because it then competes with other and better species. The importance of Yorkshire fog may be seen from its effect on perennial ryegrass and cocksfoot; indigenous perennial ryegrass proved a very valuable grass, but if sown with Yorkshire fog, the grazing had to be heavy in the early years while the ryegrass was establishing itself, whereas, when sown by itself, ryegrass suffered very much from heavy grazing in the first few years. Indigenous cocksfoot, on the other hand, would not establish with Yorkshire fog because its very palatable seedlings were torn out of the ground by grazing. Crested dogstail, which was found to be a very useful bottom grass, and should always be included in mixtures, competed with Yorkshire fog more successfully than either perennial ryegrass or cocksfoot. Timothy was useless in competition with Yorkshire fog and, like the other poor competitors, had to be sown heavily to warrant its inclusion; while sweet vernal grass, whose behaviour was much like that of Yorkshire fog, resembled crested dogstail in remaining very winter-green.

Several mineral-efficient herbs were included in the experiments, and of these, ribgrass (*Plantago lanceolata*) was observed to be very well grazed. Yarrow, buttercup and daisy were also grazed to some extent, and it was found that all these species established themselves most satisfactorily when the manuring was heavy.

Although the above observations were made at elevations between nine hundred and fifteen hundred feet, the principles

underlying the improvement of poor hill pastures apply for lower elevations and on better soils. Thomas concludes that all grassland improvement in Wales first requires the creation of favourable conditions for the establishment of the better species, and then the sowing of the right strains of the most suitable species.

The second article in this bulletin, by Milton, deals fully with the examination of soil samples from various areas in order to discover the numbers and species of viable weed seeds present, and to assess the degree of competition which would naturally result between the weeds and the sown species. The detailed information concerning each species cannot be discussed here, but certain points of general interest may be mentioned. No association was found between the number of weed seeds in the soil and the number of seeds of plants in the vegetation growing above. Thus in young swards of under five years the quantities of weed seed were out of all proportion to those of the cultivated grasses and clovers which dominated the sward. The same was true of swards over five years, except in the case of *Agrostis* spp., Yorkshire fog and white clover. On open hill pastures, on the other hand, the chief components of the herbage contributed the largest quantities of seed in the soil. Comparing the relative amounts of weed seeds in field soils and in the soils of open hill areas, it was found that in the former the weight of buried seed was very much more than that of a good seeds mixture, while in the latter the weed seeds were not equivalent to a somewhat light mixture. The freedom of the open hill areas from the seeds of troublesome arable weeds is very important in the improvement of the pastures of such areas, although the seeds of *Molinia*, *Nardus*, rushes, sedges, heather (*Erica* spp.) and heath bedstraw (*Tormentilla*) may be present in large quantities. On the other hand, the seeds of some desirable species such as *Agrostis* and fescue may occur, and these will help considerably in improvement work involving the establishment of these plants (see also Ref. 3).

The reason for the deterioration of some poor hill pastures is discussed by Wyllie Fenton (Ref. 4) and Wilson (Ref. 5), and both authors stress the importance of changing the system of management in order to reclaim these deteriorated areas. Wyllie Fenton maintains, as other workers have also done, that continued grazing with sheep leads to the spread of mat grass (*Nardus*). Having once encroached on the better pastures, mat grass increases because it is not grazed by sheep and is therefore encouraged at the expense of the grazed species. The degree to which the mat grass spreads depends, however, on the intensity of grazing, and it is not unduly encouraged when the grazing is light. Both Wyllie Fenton and Wilson emphasize

the importance of grazing cattle on hill pastures, the former stating that mixed grazing with cattle inhibits the spread of mat grass, and the latter demonstrating how the grazing of a small Galloway herd improved the size and quality of the lambs while at the same time lengthening the grazing period after burning. Experiments at Boghall not only demonstrated this, but also showed that the cattle made it possible, except on peaty soils, to practise continuous grazing without burning, *Agrostis* becoming the dominant grass instead of *Molinia*. Although Wyllie Fenton agrees that at present it is not economic to practise the hill grazing of cattle, Wilson advocates the use of this means of reclaiming poor pastures which, he maintains, is cheaper than cultivation and the application of phosphatic dressings.

(*b*) Management and Botanical Composition of the Herbage.

Detailed consideration of the effect of the grazing animal and different fertilizer treatments on the botanical composition of the herbage will be found in the two previous articles on Crops and Plant Breeding. In future only brief mention will be made of current research which amplifies the statements there made, or which contributes something new to this aspect of grassland research.

Experiments have been conducted by Ll. I. Jones on the effect of different systems of grazing and mowing on the botanical composition of an *Agrostis*-dominated pasture on poor soil. These confirmed his previous work in showing that species varied in their behaviour towards different intensities of grazing at varying periods of the year (Ref. 6). In all Jones' experiments *Agrostis* has been encouraged by hard grazing, particularly in the spring, but in the most recent work white clover throve better under moderate grazing than heavy grazing. It is suggested that this behaviour of white clover may have been due to the low fertility of the soil, an interesting suggestion which emphasizes the need for caution in endeavouring to generalize on the subject of species behaviour. Both sweet vernal grass and crested dogstail were more successful with moderately light grazing than with heavy grazing, while the former was superior to the latter in the absence of the grazing animal. An interesting part of Jones' work which requires emphasis is the effect of overstocking and understocking on the weed population. Overstocking encouraged the growth of creeping plants, annual weeds tended to colonize the bare patches, and the small prostrate weeds increased in number. Understocking, on the other hand, allowed the larger and stronger weeds and grasses to become the dominant feature, and although the number of weeds was smaller than on

overstocked areas, their contribution to the herbage was greater by weight.

Recent work by Blackman at Jealott's Hill emphasizes the importance of temperature, in addition to the previous grazing treatment and the botanical composition, in affecting the amount of early growth to be obtained in spring by the use of nitrogen fertilizers (Ref. 7). The addition of nitrogen increased the rate of growth of the plants, particularly in the early stages just after growth had commenced; but the degree of earliness was dependent on the length of time during which the soil temperature remained between 42° and 47° Fahrenheit, as well as on the percentage of early grasses present in the pasture. Applications of nitrogen were most efficacious in inducing earliness when the rise in temperature was slow, while with rapid rises in temperature the effects of such applications were sometimes negligible. This is explained on the hypothesis that when the temperature is low, nitrogen is the limiting factor to plant growth because of the inactivity of the soil micro-organisms, while with higher temperatures sufficient nitrogen for rapid growth is liberated in the soil without any application.

Evidence obtained from pot experiments, and from plants grown under somewhat artificial conditions, while often providing very useful information concerning plant development and behaviour, must be treated with caution in any attempt to interpret the results in terms of agricultural practice. Nevertheless, such experiments are often very useful in explaining peculiarities of field behaviour which it would be difficult to study under field conditions, and also in suggesting future lines of research on a practical scale. Three investigations of this nature are described in Refs. 8, 9 and 10, all of which are concerned with the study of individual grass species under controlled conditions. Lewis' experiments (Ref. 8) consisted of treating perennial ryegrass, grown in a sand-bentonite medium of pH 7·61, with ammonium and nitrate nitrogen and studying their effects on the growth of the plants when cut at different stages. The results showed that there was a more rapid uptake, and a more efficient use by the plant, of the ammonium nitrogen than the nitrate nitrogen, the former giving significantly greater yields of dry matter, particularly in the early cuts. The percentage of dry matter in the cut herbage was roughly inversely proportional to the percentage of nitrogen, and except in the first cut made on the short grass, there was a higher nitrogen percentage in the cut herbage which had been dressed with sodium nitrate than in that treated with ammonium nitrate.

Caldwell and Richardson (Ref. 9) also conducted pot experiments on the effect of ammonium sulphate, but in their case alsike and red clover were used. They concluded that there

was no evidence that ammonium sulphate was toxic to the clovers—in fact there was a stimulation in the early stages—and they suggest that clover repression is due mainly to the competition of the more strongly stimulated grasses. These results are interesting in relation to the use of ammonium sulphate for the stimulation of the grass element in pastures and lawns at the expense of the non-gramineous species.

The detailed specific behaviour of perennial ryegrass and of timothy grown in boxes and cut at ground level, half-an-inch high and an inch high, at 10-day and 30-day intervals, is described by Roberts and Hunt in Ref. 10. The effect of the cutting was measured in terms of root and shoot growth by calculating the dry weight, fresh weight, length of roots and number of tillers. All forms of cutting checked the root growth of perennial ryegrass, and the extent of the check to growth depended on the severity of cutting. Timothy behaved very similarly, but the 10-day cutting did not check the roots to the same extent as in the case of perennial ryegrass. Both species suffered a check to shoot growth by the cutting.

The significance of this work from the agricultural point of view lies in the different kinds of check to root growth shown by these two species. There was strong evidence that food is stored in the roots of perennial ryegrass, because these organs suffered a severe check in weight increase when the shoots were cut. It seems, therefore, that the food in the roots is transferred to the shoots after the latter have been cut. Timothy did not behave in this way, there being no sudden check in the weight of roots after cutting, and the authors conclude that this is because in this grass the reserve food is stored in the bulbous base of the shoot and not in the roots. It is suggested that this difference in specific behaviour may be important from the point of view of the survival and persistency of the two grasses under heavy grazing, perennial ryegrass being very persistent and timothy quickly disappearing under these conditions in North Wales. It is obvious that under heavy grazing timothy must lose the large part of its food reserve owing to its being eaten by the grazing animal. Perennial ryegrass, on the other hand, escapes this depletion because the food storage is underground, and can be drawn upon to replenish the young developing shoots after grazing.

Further work on the effect of cutting on the food reserves of the plant is described in Ref. 18. The object was to investigate the effect of cutting red clover on the plant's carbohydrate reserves, because of the relation of the latter to the power of renewing growth and the ability to overwinter. It has previously been shown by Sylvén and Grandfield independently that lucerne has a long critical period of cutting in the autumn,

and Sylvén claims that a very late cutting did not endanger the overwintering. Grandfield, on the other hand, showed that cutting reduced the carbohydrate reserves in the roots, early and frequent cutting resulting in a lower, and infrequent cutting in a higher, carbohydrate content at the beginning of the winter. The carbohydrates in the roots are the available food supply for growth in the spring, and it is generally thought that high carbohydrate reserves ensure better wintering. Virtanen and Nurmia's work with Finnish red clover showed that cutting did not significantly affect the content of sucrose and other soluble sugars, the amounts of which were very low during June to August, but rose in the autumn. On the other hand, the total carbohydrates suffered a loss due to cutting and if the depletion coincided with autumn frosts there was liable to be a bad effect on overwintering. Nevertheless the apparent power of the plant to increase the soluble sugars after late cutting practically compensated for the decrease in insoluble carbohydrates, in consequence of which the total carbohydrates were higher with the later cuts.

Accounts of experiments of a more practical nature are given in Refs. 11 and 12. The first is an account of manuring investigations of meadow land in Sweden. It is stated that, although phosphatic and potassic fertilizers favour the growth and increase the persistency of clovers, these fertilizers also increase the persistency of the better grasses such as timothy. The effect of fertilizers on the amount of clover and the total weight of hay at Craibstone is described in Ref. 12. Liming increased the amount of red clover in both hay and aftermath, and also increased the total weight of hay and aftermath. Lack of phosphorus depressed the amount of clover, and there seems little doubt that this mineral has a wider application, and a more uniform effect, on the growth of clovers than any other fertilizer.

(c) Species and Strain Investigations.

Experiments on the behaviour of different strains of red and white clover at Craibstone (Ref. 12) showed that, of the red clovers, the late-flowering forms gave more clover in the hay than the broad red types. Within the late-flowering group, the earliest form, American Mammoth, was the poorest. The English Eastern-Counties strain was the best, being superior to the latest Montgomery and Swedish forms. In the aftermath, however, the Swedish late-flowering was the most satisfactory, with the English Eastern Counties second. Among the broad red strains Vale of Clwyd gave the best results in both hay and aftermath. In the aftermath alone the broad red strains were generally as good as the late-flowering strains, while English broad red and Vale of Clwyd were distinctly better.

The effects of red clover on the grasses and on white clover were also investigated at this station. Too much red clover depressed the grasses, and it is advised that care should be taken not to include too heavy a seeding of any one clover type in a seeds mixture. There was a similar effect of red clover on some strains of white clover, and it was concluded that it is useless to include ordinary (Dutch) white, or any white clover that gives a weak chemical reaction, in a mixture with red; the white clover is prevented from developing in the first year, and it usually dies out in the second.

Experiments on the feeding value of mixtures sown with different species and strains of grasses and clovers are described by I. Jones in Ref. 13. In very simple mixtures he found that the greatest increase in the live weight of grazing sheep, over a period of four years, was obtained from wild white clover and perennial ryegrass, with wild white clover and cocksfoot second, and perennial ryegrass and cocksfoot, without wild white clover, third. In pure species plots perennial ryegrass was superior to cocksfoot, while the productivity of wild white clover was more satisfactorily maintained when it was sown with perennial ryegrass and cocksfoot together, than with either of the species separately.

In more complex mixtures to test the relative value of commercial and indigenous strains, the latter gave a greater live-weight increase and a higher stock carrying capacity. The best financial and agricultural results were obtained by sowing wild white clover with indigenous strains of red clovers and grasses, with perennial ryegrass included in preference to cocksfoot. Hays cut from indigenous seeds were also leafier and heavier than those from swards established from mixtures of commercial strains. The great importance of including wild white clover in mixtures was again demonstrated; pastures in which this species was included were more than 30 per cent. more productive from the point of view of live-weight increments, and possessed a stock carrying capacity nearly 15 per cent. higher than pastures sown without the wild white clover.

(*d*) Species and Strain Improvement.

The improvement of grasses and leguminous plants for growth in particular areas is as much a study of the relationship of the plant to its environment, and of plant adaptation, as of plant breeding in the more restricted sense. In developing grassland areas, or areas for growing forage crops, considerable spade work on ecological lines has to be done before hybridization can be usefully attempted. The results of this type of work may be seen in this country in the development of local or indigenous strains, and have been discussed in previous articles

of this series. Further accounts of investigation of the same nature may be found in Refs. 14 and 15, which describe methods and problems in parts of Canada. Trials with single species and strains to determine their productivity, their responses to grazing and manures and their palatability are as much plant-breeding problems as general grassland problems. Where the conditions are highly specialized, owing to extremes of climate, questions of the relationship of the plant to its environment become increasingly important in grassland improvement work. In Western Canada, for example, the climatic conditions in the areas of dry-land agriculture practically limit the choice of forage crops to brome grass (*Bromus inermis*) ; slender wheat grass (*Agropyrum tenerum*) ; crested wheat grass (*Agropyrum cristatum*) ; lucerne (*Medicago sativa*) ; and sweet clover (*Melilotus*). Attempts are being made to improve these species by selection and hybridization. Inbreeding and selection have produced improved strains of brome grass with a restricted spreading habit, while the Fairway strain of crested wheat grass, which possesses half the normal number of chromosomes, has been produced by similar methods. The improvement of lucerne by self-fertilization has been unsuccessful because the Grimm strains, which are exclusively used, lose vigour when such methods are used. Attempts are being made to produce higher seed-producing strains, in order to cheapen the seed, and also one-cut and pasture types. It is considered that Grimm cannot supply these latter needs, and new varieties and hybridization with the closely related species, *Medicago falcata*, are being tried. Inter-specific and inter-generic crosses are also being investigated with a view to the improvement of sweet clover (*Melilotus*).

Reference to these methods of herbage-plant improvement in Canada has been made particularly to emphasize the fact that every problem of this nature requires special treatment. After detailed studies of the plant and its environment have been carried out, the breeder has to decide what methods can most profitably be employed for improving the available types. In some cases selection within the naturally occurring forms, followed by hybridization, is the obvious means. In other cases hybridization between different species of the same genus, or even between different genera, is being investigated as a means of producing new forms. Natural hybrids involving the genera *Agrostis* (bent grasses), *Festuca* (fescues), and *Lolium* (ryegrass) are known, while specific crosses involving these genera and many others, such as *Agropyrum*, *Alopecurus*, *Bromus*, *Dactylis*, *Phleum* and *Poa* have also been found. Artificial species hybrids have been proved to be of economic value in a few cases. An example is the "Oldenburg ryegrass" (*Lolium perenne* and *L. italicium*), which combines the longevity and greater winter hardiness of perennial

ryegrass with the greater yield of Italian. Amongst leguminous plants, *Medicago sativa* (lucerne) and *M. falcata* (spotted medick) have been hybridized with varying success in several countries. It is suggested that inter-specific hybridization might be profitably used on other species of herbage plants, as for example in the genus *Dactylis* (to get rid of the tuft-forming habit of cocksfoot) and in the genus *Festuca* (to produce forms of meadow fescue which would be more strongly aggressive in pasture (Ref. 16)).

A simple and elementary account of the significance of strain in herbage plants is to be found in Ref. 17. Although some of the information is relevant only to conditions in New South Wales, the general agricultural considerations are true for all environments and are easily appreciated by the practical agriculturist.

II.—MODERN TENDENCIES IN PLANT BREEDING PROCEDURE.

The means employed by plant breeders to improve the varieties of cultivated plants are of considerable importance to growers, because such means must to a large extent determine the type of improvement it is possible to achieve. The procedure adopted in plant breeding is largely determined by the crop which it is desired to improve, and by the agricultural and economic problems which have to be solved. It is impossible to generalize as to the most promising means of improving crops; each species requires separate consideration, and improvement cannot always be achieved by the same methods. Plant-breeding problems are agricultural problems and, just as it is important for the plant breeder to appreciate the agricultural and economic considerations which make certain improvements desirable, so should the agriculturist be at least generally familiar with plant-breeding procedure. One of the easiest things in plant breeding is to produce forms which are new and different from those already in cultivation; but it requires very careful and patient work over a number of years to place on the market a new variety which is a definite improvement on the old ones, or which fulfils some specific economic or agricultural requirement. Such cereal varieties as Yeoman, Little Joss, Victor, Wilhelmina and Holdfast wheats, Spratt-Archer and Plumage-Archer barleys, Eagle, Onward and Resistance oats, are all the results of breeding with a definite object in view.

During the last few years increased scientific knowledge has been instrumental in introducing new conceptions in plant breeding, and has opened up new possibilities of producing improved forms of plants. In most parts of the world plant breeders are busily exploring these new possibilities and things

are being attempted which, only a few years ago, were considered quite impossible. Apart from actual achievements the newer methods are of great interest in foreshadowing the possibilities of the future. In the brief review which follows reference is made to achievements of practical importance with crops which are not grown in this country, because it is only by this means that the significance and value of the modern research may be measured.

(a) The Use of Wide Crosses.

During the present century hybridization has become the most important method of plant breeding because it offers the greatest chance of producing improved types. It is often possible by hybridizing two forms, each possessing some desirable characters, to combine those characters in one plant, or even to produce plants which are superior in some characters to either parent. In agricultural plant breeding, considerable improvements have resulted from close breeding, involving the hybridization of nearly related forms or even forms which are direct blood relations. For example, many of the more popular varieties of barley of this and other countries are derived, by selection and hybridization, from the old Archer variety, while the old Squarehead wheat, and Probstier and Black Tartarian oats have similarly given rise to many widely cultivated forms. In temperate countries with a high standard of agriculture, this method of breeding by selection and hybridization with the families of proved parents has, over the last 25 or 30 years, produced many improved varieties of cereals.

In recent years, however, research has shown that it is possible to obtain stable forms by hybridizing plants belonging to different species, or even to different genera. By this means new forms can be produced combining characters which it would have been impossible to combine by close breeding. It is indeed suggested by some investigators that the old close-breeding method has been fully exploited and that future advances in plant breeding will be possible only by the use of these so-called "wide crosses." There is little doubt that this is a wrong conclusion, but the possibilities of wide crosses are being investigated in many countries at present; results, so far, and on the whole, are disappointing, but some achievements may be mentioned.

Inter-specific and inter-generic hybrids are usually characterized by a high degree of sterility and by the production of large numbers of abnormal and worthless progeny. In spite of this difficulty careful selection work, and also the use of back-crossing, sometimes lead to the isolation of valuable plants. Sterility may be partial or absolute, and although the degree of

sterility is of vital importance in plants which are propagated by seed, it may be quite unimportant in crops which are propagated vegetatively as, for example, sugar cane, bananas and potatoes. In such plants the production of true-breeding forms is unnecessary, and improvement by wide crossing is therefore much easier than in those plants which are propagated by seed. It is common knowledge that most crop varieties that are vegetatively propagated do not breed true from seed. This is of no practical importance provided the vegetative parts which are used for propagation always give rise to plants that are uniform as regards their agricultural characteristics.

Some of the outstanding results of the use of wide crosses are to be found in such vegetatively propagated types of plant. For example, hybridization between forms with different numbers of chromosomes has resulted in the production of new disease-resistant types of banana, while the sugar cane offers perhaps an even better example of the application of this method of breeding. As with the banana, cultivated forms of sugar cane are hybrids resulting from natural or artificial hybridization, but the types which yield most sugar belong to the species *Saccharum officinarum*, and are termed " noble " canes. These noble canes are, however, susceptible to certain diseases which ravage the crop. Now it has been discovered that forms of the species *S. spontaneum* and *S. robustum*, although inferior in sugar yield, possess a high degree of disease resistance, and these two species are being used in some countries for the transfer of this disease resistance to the noble varieties. In addition to simple species crosses involving the above species and *S. barberi*, triple species crosses of *S. officinarum* × *S. spontaneum* × *S. barberi* are being made in India in the search for disease-resistant forms (Ref. 19). Important practical results have already been obtained in this way and the most valuable forms at present cultivated owe their origin to this method, while improved noble canes, possessing disease resistance, are being further utilized for hybridization with native varieties (Ref. 20).

Experiments are also being made on the hybridization of the genus *Saccharum* with the genera *Sorghum* and *Erianthus*. For the most part this work is experimental and nothing of real economic value has yet resulted; crosses involving *Sorghum* varieties with *Saccharum officinarum* seem to be the most promising. The object of these crosses is to obtain earlier-maturing forms of cane with a wide range of growth. Earliness and a fair sugar-content have been obtained, but there is a lack of vigour in all the selections so far made. There is a possibility, however, that this lack of vigour might be remedied by back-crossing the hybrids on to sugar cane (Ref. 21). There also appear to be some natural hybrids of *Saccharum* and *Erianthus*

which are cultivated as sugar cane in parts of the world; but these are, for the most part, native forms of but little economic importance. Although these generic crosses are usually characterized by very high degrees of sterility, one example of extraordinary fertility has been observed in a sugar cane × millet hybrid (Ref. 23).

Wide crosses involving hybridization of wheat with the genera *Agropyrum*, *Secale* (rye) and *Aegilops* have attracted considerable interest during the last few years. There is an extensive literature on this work, but a great deal of it is of purely academic interest and need not be considered here. A selection of the more recent accounts of these generic crosses in wheat is included in Refs. 24 to 42, but many of these are in Russian. As far as may be judged, the work has not gone far enough for the true value of this method of breeding to be assessed, nor is it probable that all the possible means of exploitation have as yet been tried. The most promising crosses are those between *T. vulgare* (the bread wheats) and certain species of the genus *Agropyrum* (to which belongs the common couch grass) because these two genera appear to be closely related. These crosses differ from most inter-generic crosses in producing a large number of intermediate forms, a natural consequence of the chromosomal relationship of the two genera. Very promising annual wheat forms, which breed true and have the same number of chromosomes as the bread wheats, are reported by Veruschkine as resulting from crosses involving these two genera (Ref. 24). Some of these possess good baking quality and resistance to bunt and smut, while others yield grain which makes better bread than the standard bread wheat used in the investigation. Amongst the intermediate forms are some disease-resistant forms which are highly productive in spite of their having small grain, it being claimed that they yield twice or three times as much grain, of a higher protein-content, than the standard bread wheat variety. These intermediate forms have 56 chromosomes compared with the 42 chromosomes of the bread wheats, and represent, according to the investigators, an entirely new range of wheat types.

One of the objects of these crosses between *Triticum* and *Agropyrum* is to obtain extremely hardy, perennial wheat forms. The perennial types so far bred have resembled the *Agropyrum* parent too closely to be of any great value, and it appears to be a very complex problem to combine a reasonable size of grain with cold-resistance and the perennial habit. But the most promising method of obtaining perennial wheats seems at present to be by this form of hybridization with species of *Agropyrum*, because of the greater ease of crossing, the higher fertility of the hybrids (which often increases from year to year)

and the greater combination of desirable characters in this genus (Ref. 25). Veruschkine does not consider that the new forms which appear as the result of these wide crosses are all due to hereditary recombinations, but agrees with another investigator, Meister, that some of them result from mutations, or "sports," which are stimulated by the process of hybridization.

Results like those described by Veruschkine are reported by other Russian workers. Derzavin (Refs. 26 and 27), who claims to have stimulated the quest for perennial forms of agricultural plants by his discovery of a perennial barley in the mountains of Transcaucasia in 1930, states that he has obtained wheat forms with increased yield, and with resistance to brown rust and drought, by hybridization and selection of wild and cultivated forms. Deržavin is also working with rye, vetches and sorghums in an endeavour to produce perennial forms ; while an interesting experiment with sunflowers has as its object the production of forms which produce both seeds and tubers. Tzitzin (Refs. 28, 29 and 30) reports hybrids from *Triticum* and *Agropyrum* which successfully resisted droughty conditions and dust storms which were disastrous to wheat. Annual forms with a high yield and a satisfactory thousand-corn weight were selected, while the constant perennial forms, although initially possessing a low thousand-corn weight, are apparently improving in this character, and also in yield, from year to year. These perennial forms are thought to be of value for the far north and for arid conditions, because they are very early and also because they have inherited the luxuriant root system of the *Agropyrum* parent and are very drought-resistant. Tzitzin's annual hybrids also excelled the wheat parent in yield, quality and disease resistance, and it is interesting that he found the *Agropyrum* parents to possess grain of very high protein content, which was very easy to mill and gave a high yield of flour. Hybrid forms were selected which gave flour of excellent texture and colour, and the loaves were of a better size and porosity than those from common wheat (*T. vulgare*) flour. Cicin (Ref. 31), in crosses between various species of *Agropyrum* and soft and hard wheats, found that all the hybrids were perennial and showed an equal tendency to vegetative and sexual reproduction. Most of his first-generation plants were self-sterile, so that he found it necessary to back cross them. The percentage of perennial forms decreased with each generation, and in later generations he was able to select valuable annual and perennial forms, some of which were very vigorous and produced many tillers, a character which suited them for forage purposes. Khiznjak (Ref. 33) also refers to a considerable degree of sterility in crosses of *T. vulgare* and *T. durum* with species of *Agropyrum*, and describes the use of back-crossing to increase

fertility. By this means he was able to select very vigorous perennial wheat-like types with fair fertility.

Hybridization of *Triticum* forms with the genus *Secale* (rye) does not appear to have given such promising types as the hybridization of *Triticum* with *Agropyrum*. Nevertheless a new grass *Triticale* has been named as a result of crosses between the two former genera, and forms of this are said to be cultivated on a wide scale in parts of Russia. The most promising types are constant, 56-chromosome, forms; Katterman gives accounts of this work in Refs. 34, 35 and 36. Katterman, however, does not think that there is a strong probability that such constant intermediate forms will be repeated with back-crossing methods, and the forms which have already been produced are being investigated. N. G. Meister (Ref. 37) states that these 56-chromosome forms (amphidiploids) were not of sufficient value to be released for general cultivation, but they are being used for further hybridization. He found that the most satisfactory results were to be obtained by back-crossing the first-generation hybrids to wheat, by which method new and valuable forms with regard to yield, disease resistance, quality, earliness, cold-resistance and drought-resistance were obtained. G. K. Meister (Ref. 38) reports constant perennial rye-wheat hybrids with excellent quality, in addition to crosses of *Agropyrum* with both *Secale* and *Triticum*, while a valuable rye-wheat hybrid has apparently been produced at the Saratov station in Russia; it is said to be extremely winter-hardy, disease-resistant, with high tillering and high yielding capacity, good quality and large grain (Ref. 38).

Crosses of the genus *Aegilops* with *Triticum* have been tried from time to time, but for the most part the results have been of interest with regard to the relationship of these two genera rather than in the production of new and improved forms. Two accounts of investigations involving these genera are given in Refs. 40 and 41, while reference to the use of Aegilops for the production of drought- and disease-resisting forms is made in Ref. 42. As in most generic crosses, the first generation hybrids are sterile, and the usual procedure of back crossing to wheat has to be practised in order to extract fertile types. Occasional fertile amphidiploid plants are found in the first generation, as has been mentioned in other generic hybrids, and these plants are constant because of their chromosomal complements. In Ref. 42 mention is made of crosses between the genera *Haynaldia* and *Triticum*, but these do not appear to be important; the only fertile plants which have appeared are in the cross *Haynaldia* × *T. turgidum* (Rivet wheat).

Species crosses in wheat have been widely investigated, mainly with the object of producing disease-resistant forms of

Triticum vulgare, or bread wheat. Some of these species crosses are easily accomplished, and there is a high degree of fertility in the progeny; other crosses are very difficult or have proved impossible up to the present, and in some cases all the progeny is sterile. The reason for this difficulty is the difference in chromosome number between some species; those forms which are most dissimilar in this respect being difficult to hybridize. Crosses which have proved successful from the economic point of view are those involving the species *vulgare* and *durum*; these have resulted in the two varieties Marquillo and Thatcher which are resistant to stem rust (*Puccinia graminis*). Marquillo was derived from a cross between Marquis (*vulgare*) and Iumillo (*durum*), while Thatcher is a complex hybrid extracted from Marquis-Iumillo × Kanred-Marquis. Both varieties have been produced, and are being grown, in the United States, but Marquillo has never become a commercial success because the grain contains the yellow colouring matter of Iumillo which persists in the flour and in the bread. Another bread-wheat variety resulting from a species cross (*vulgare* × *dicoccum*) is Hope. This again has never been widely grown because, although it is resistant to stem rust and smut and is of fair baking quality, it does not yield well and is susceptible to heat and drought (Ref. 43). Hope is quite remarkably resistant to stem rust, approaching in fact the near-immunity of the Yaroslav emmer wheat which is one of its parents. It is, therefore, being used, together with an allied strain designated as H-44, as a disease-resistant parent in further crossing, and a new variety called Apex has been produced at Saskatoon, Canada, as a result of a complex cross involving these two forms. Work in the United States is continuing in the search for disease-resistant forms to combat the serious epidemics which occur from time to time, and in addition to Hope and H-44, other varieties such as Ceres, which is the most widely grown hard spring wheat in that country, and an Australian variety called Florence, enter into the programme. Finally, the species *T. timopheevi*, which shows complete immunity to rusts, smuts and mildews, is being investigated. Unfortunately, it is being found extremely difficult to hybridize this species with the *vulgare* or bread wheats, and up to the present no progress has been made with it as a parent.

Species hybrids have been, and still are being, produced in many other crops. Attempts are being made to produce disease- and frost-resistant potato varieties by crossing with wild species (Ref. 44), while in *Avena* (oats) (Refs. 45 and 46), *Nicotiana* (tobacco) (Refs. 47 and 48), *Gossypium* (cotton) (Ref. 49), *Brassica* (swedes and turnips) (Ref. 46), *Medicago* (lucerne) (Ref. 50), species crosses are also being investigated. In some

cases little has been done to improve the cultivated forms by this means, and the attention of the research worker is at present engaged on the more academic problems. In the case of the potato and oats, however, breeding work has been directed on more economic lines, and has a direct interest for the British farmer. Many new species of potato are being investigated in order to find forms which may be used in breeding new varieties which can be grown under conditions where the existing varieties fail, or which may be used in the search for disease- and frost-resistant varieties. Successful inter-specific crosses for frost-resistance are reported by Russian workers who are hybridizing the domestic potato (*Solanum tuberosum*) with *S. curtilobum*, while the species *S. demissum* is also being used. Disease resistance, particularly resistance to wart and blight, is also being sought by these means in this and other countries, and *S. andigenum*, *S. demissum*, *S. Antipoviczii*, *S. neoantipoviczii*, *S. ajuscoense* and *S. Aya Papa* are being investigated. Hybridization of *S. tuberosum* with *S. demissum* has so far proved disappointing because of differences in chromosome number, but some of the other species have the same chromosome number as the domestic potato and are therefore more promising. In the case of oats, E. T. Jones at Aberystwyth has hybridized *A. sativa* with *A. sterilis*, and *A. brevis* with *A. strigosa*. By this means improved forms of oats have been produced which are cultivated in some parts of Wales.

(*b*) The Alteration of Chromosome Number, and the Inducement of Mutations by Artificial Means.

It has been mentioned above, in discussing the significance of wide crosses, that new forms with increased chromosome numbers are often produced. These forms are called "*polyploids*" and the hybridization of different species or genera is the most important method of producing such polyploid plants. But hybridization sometimes leads to a halving of the parental chromosome number and the production of what are termed "*haploids*." For the most part these haploids are of no economic significance, and the polyploid forms are more important in plant-breeding work. Hybridization is not, however, the only means by which the chromosome number of plants can be altered, experimental work having shown that this may be accomplished by exposing plant tissues to abnormal conditions. A brief account of the various plant species which have proved susceptible to various treatments, including exposure to X-rays and high temperatures, injection which chemicals, injury and centrifuging, is given in Ref. 51, while an account of polyploid hybrids is also given in this reference. The alteration of chromosome number by means other than hybridization has proved of

considerably less value than the alteration by hybridization, and need not be discussed here. Nevertheless the possibilities of using such means, and the possible occurrence of natural polyploids through exposure to extreme climatic conditions, should not be overlooked. Mutations, or "sports," may also arise by artificial treatment, and a good deal of work has been done with X-rays in this connection. Up to date, such mutations have been entirely useless from the plant-breeding point of view because they have proved to be for the most part retrograde steps instead of improvements.

All these methods of changing the chromosome complement of plants are attempts to induce a variability greater than that which can be achieved by close breeding. Investigators engaged upon such work hope that new forms of plants may be produced with combinations of characters unknown in any existing cultivated types. Some of these investigators also feel that little further progress can be expected from close-breeding methods because most of the useful combinations of characters have already been made. If this is the case, and if plant breeding is to continue to serve any useful function, it is essential to introduce new characters by other means. It is doubtful, however, whether such views are applicable to many crops, and whether many plant-breeding problems can be solved by the means advocated. These questions will be briefly discussed in the following section.

(c) The Present Position of Plant Breeding.

Workers in plant breeding are at present following up the new and stimulating ideas which have resulted from modern genetic research. It is unlikely that the new methods will be equally useful in all cases, and each breeder has to decide for himself how far such methods as wide crosses and induced polyploidy will prove useful to him. Outstanding success has been obtained by wide crossing in sugar cane, while this method has also had some success in wheat improvement. The full significance and the economic value of the inter-generic crosses with wheat remain to be seen, but it is probable that they will have only a limited application under special conditions. The use of such extreme methods will probably be justified only in extreme cases, and where the immediate problem cannot be solved by the older and more refined methods. In the examples quoted it has been found necessary to turn to related species or genera because some important character was lacking in the cultivated forms. In some cases the very existence of the cultivated crop has been threatened by epidemic disease, while in others the aim has been to produce completely new forms for extreme conditions. In this country we have no great extremes of climate, and epidemic plant diseases, except perhaps in the

hop and potato crops, are relatively unimportant. It follows that cereal breeding, in the immediate future, will probably be most successful if it is conducted along the old intensive lines, whereas if any radical improvement is to be made in the disease- or cold-resistance of the potato, specific crosses will be necessary.

These two examples emphasize the present position in plant breeding. Investigations now in progress may possibly prove the desirability of research programmes on cereal improvement by wide crossing, but such programmes, if they are to produce results, must be of a long-term character and will necessarily be expensive to carry out. Experienced breeders throughout the world are anxiously considering the next steps in the improvement of their crops and it may be worth while summarizing some of their most recent views. Coons (Ref. 54) believes that sugar beet improvement in all beet-growing countries may possibly depend on hybridization with garden beet, Swiss chard, mangolds and *Beta maritima*. Such a step would introduce into the crop that greater variability which is particularly wanted, all modern varieties of beet being closely related genetically. On the other hand, according to Garner (Ref. 52), most tobacco breeders are of the opinion that improvement of this crop by hybridization should be mainly restricted to strains or varieties that are closely related genetically. These tobacco breeders consider that speculative wide crossing is a waste of time because of the complexity of the inheritance of the economic characters, the difficulty of selection and the subtilty of environmental influences. Tobacco is a good example of a crop whose economic value is dependent on obscure questions of quality, where the introduction of new blood by wide crossing would probably lead to deterioration and almost certainly result in great confusion. Inter-generic hybrids of maize have been produced, but apparently American breeders are not hopeful of useful improvements by the use of wide crosses. On the other hand, Jenkins (Ref. 53) considers that greater knowledge of the inheritance of important economic characters is the most urgent need in maize breeding, but sees some promise in the idea of doubling the number of chromosomes (by the application of heat to the young ears). Such a procedure creates the possibility of fertile hybrids among species which differ in their chromosome numbers.

It seems reasonable to conclude that the value of the newer methods of plant breeding will ultimately depend on the particular crop, and on the kind of improvement which the economic and environmental conditions demand. Where intensive methods of breeding, continued over many years, have resulted in the production of highly specialized varieties in countries with equable conditions, there is good reason to expect further improvements by a continuation of the old and well tried methods.

It is true that with each successive step of improvement the next becomes more difficult, and that a time may come when it is necessary to resort to different and more drastic methods. It is, however, unreasonable to expect a plant breeder to hybridize highly specialized varieties with other species which possess no particular character that he desires; it would be just as reasonable to ask breeders of highly improved Jerseys or Friesians to try a cross with a zebu or a bison. On the other hand, the possible advantages of inducing greater variability cannot be overlooked; it is impossible to predict the range of forms which may result from the hybridizing of two plants which differ widely in their genetic constitutions and environmental requirements. Most plant breeding stations are therefore carrying on speculative crossing of this sort while at the same time continuing breeding by the old and well proved methods.

In contrast to the use of wide crosses is the hybridization of individuals within one variety. For many years it has been recognized that varieties of self-pollinated crop plants may be mixtures of more or less closely related forms, and the production of new varieties by selection and hybridization within such varieties has often been claimed. The possibility of improvement by such methods is greatest in the case of old-established varieties which have not been subjected to selection, and also in hybrid varieties of varying ages. In the former case there is liable to be an admixture of types of unknown origin; in the latter new forms may have segregated from what at first appeared to be a uniform population, it being humanly impossible to ensure that such a population is true-breeding for every character. In relation to the latter point it is well known that hybrid varieties may sooner or later throw "off-types," which may detract very considerably from their economic value. In such cases it is necessary to re-select and isolate the superior forms if the standard of the original variety is to be maintained, and hybridization between selected plants may be practised as a possible means of further improvement. The ephemeral nature of hybrid varieties need not, in itself, be a disadvantage, but it does entail constant observation on the part of plant breeding authorities and seed houses to ensure that pure stocks are always available to growers. Indeed this very instability may be a source of valuable new stocks, and its occurrence serves to emphasize the need for a constant and unbroken sequence of research work on plant breeding problems.

The Russian investigator Lysenko has lately claimed to have made very rapid improvements in wheat by selection and hybridization within a single variety. In his earlier works Lysenko admitted that a variety might change and become a mixture of types through segregation (Ref. 62), but in later works

he denies this, and says that self-pollinated crops degenerate because of the too great similarity of their reproductive cells (Ref. 55). Whatever the explanation—and most geneticists would agree that it is segregation—there is no doubt that hybrid varieties are seldom true-breeding for all their characters; this fact suggests the question as to how far it is necessary or desirable to have complete homozygosity (*i.e.*, true breeding for every character) in varieties of cultivated crops. It is very probable that a certain amount of genetic variability in a variety is not undesirable, provided, of course, that the economic value of the product is unaffected. Genetic variability means greater adaptability and, while there is no clear evidence on the point, many practical men believe that the highest yields are to be obtained by mixing varieties together. The question as to how far it is economic for a plant breeder to pursue the quest for the completely homozygous strain has never been answered, but there is every reason to think that the importance of "purity of seed" can be overrated if by purity we mean strict genetic purity. The completely stable and true-breeding variety may not be altogether desirable even if it were possible to obtain it, though *relative* stability of important economic characters must, of course, be secured. Homozygosity (purity of type) is, strictly speaking, only a relative term, and it is interesting that some breeders have come to the conclusion that a "relatively high degree of homozygosity" is in some cases all that need be secured.

(*d*) Plant Breeding and Scientific Developments.

Genetics is concerned with the study of hereditary phenomena, while cytology is largely concerned with the behaviour and structure of the chromosomes which are believed to control the heredity of all living organisms. Both these sciences should, therefore, have a direct influence on plant breeding. Many investigators feel that genetics and cytology have placed plant breeding on a firm scientific basis. Unfortunately, although plant breeding is directly dependent in some ways on the findings of genetic and cytological research, it is still far removed from being an exact science. The reason is that genetics, which has been of a great service in explaining the method of inheritance of many characters in plants, has so far failed to elucidate the heredity of the important physiological and economic characters with which the plant breeder is concerned. Genetic science is concerned largely with the study of more or less simple morphological characters such as flower colour, chaff colour and grain colour, although some characters of a more complex kind have been studied and explained. Plant breeding, on the other hand, is mainly concerned with characters like earliness and lateness,

quality, yield, and resistance to lodging. These characters are very complex, are very strongly affected by environment, and are difficult to measure by eye. Moreover, many of them are not completely understood because the development and behaviour of plants have not been sufficiently studied by botanists. The plant breeder is, therefore, in some cases, in the position of working with characters whose real nature is not understood and whose mode of inheritance is not known. In these circumstances he is, like the animal breeder, dependent for any success he may achieve on his experienced eye judgment.

How far plant breeding has become a science and how far it remains an art, depends, of course, on the type of breeding work being done. The matter is of some importance to the farmer because it might appear from the writings of some investigators that the plant breeder can now produce improved varieties to order with mechanical regularity and precision. The fact is that this state of affairs has not yet been reached ; it is still possible for a plant breeder to achieve great success without any scientific training whatsoever. This does not mean that science has not helped in the solution of many problems, and, indeed, much of the routine work of plant breeding is based on scientific knowledge which has made for the saving of much time and money. A brief general discussion of the application of scientific methods in plant breeding is given by Bell in Ref. 56, while further views of a more special nature may be found in Refs. 57–67. A perusal of these papers will show that many geneticists and cytologists tend to regard plant breeding as an applied science, while the experienced plant breeder regards his work as still largely an art, dependent for its success on the personal judgment and skill of the breeder.

For the present the truth seems to lie between these two extreme views. Genetics and cytology have both contributed a great deal to plant breeding procedure, but their application is as yet limited. The successful selection of individual plants from hybrid populations, which is the key to plant improvement by hybridization, is still largely a matter of personal skill and judgment. On the other hand, chemical, physical and statistical aids to selection can be utilized with some success in certain stages, and may often help the breeder towards the greater control and precision which he so much needs. Before any great advance can be made in the endeavour to make plant breeding a really scientific business, a good deal of work is necessary on the physiology and development of the plant, combined with an intensive study of the nature and mode of inheritance of those character complexes which are loosely termed "economic characters." When further knowledge on these matters is available, and when the hereditary constitution of

individual plants can be accurately analyzed and distinguished from the effects of environment, then plant breeding will have made a great advance towards becoming a science.

The general organization of plant breeding in various countries of the world, and the methods at present employed in the improvement of different crops, are described shortly in the Report of the International Congress of Plant Breeders (Ref. 68). This report gives interesting accounts of the various types of organization which all progressive countries possess, not only for the *production* of new and improved varieties of cultivated plants, but also for the *maintenance* of these improvements and their quick and efficient dissemination to farmers. The duty of the plant breeder to the agricultural community does not stop with the production of improved forms; but there must be an efficient means of passing on these forms to the farmer and an organization to ensure a plentiful supply of seed. Unless consideration is given to these latter points, there is liable to be, at the best, a long lapse of time between production and utilization, while, at the worst, improved varieties may never be able, because of lack of advertisement, to show their true worth. In some countries, state-aided plant-breeding institutes are provided with the necessary machinery for marketing their products and providing the farmer with the necessary information about them. Unless this is done, the old-established varieties and new sorts that are well advertised will be those that are grown, and the true value of the plant breeder's work may never be realized. The only true test of the economic value of a variety is the success it achieves once it has become known and is available for general cultivation; it then automatically finds its own level. Until that stage has been reached a certain amount of propaganda is necessary on the part of those who are responsible for supplying seed to farmers and advising them as to the most profitable varieties to grow.

III.—WHEAT.

(a) Quality.

Many countries are endeavouring to become self-sufficient in the matter of essential foodstuffs and, as one might expect, a good deal of attention is being focussed on the breeding of wheats of good baking quality. The subject was discussed generally in the last issue of this *Guide*, and recent trials and breeding work in this country were described. The work is still being hindered by the lack of any reliable test for small samples of grain. In 1934 the Imperial Bureau of Plant Genetics, Cambridge, published a bibliography on baking quality tests in which some of the more important methods are briefly discussed (Ref. 69). The whole of this bibliography is most useful to the breeder, but the

only part of direct importance to the farmer is that which discusses the possibility of judging baking quality from the physical characteristics of the grain. The most useful characters are vitreousness, hardness, colour, feel, bushel weight and size of grain (thousand-grain weight). Opinions differ as to the exact value of these characters in assessing quality; but most investigators agree that their value varies with the conditions and with the varieties under consideration, and that no one character by itself is sufficient guide. For example, the vitreousness (flintiness) of the grain is one of the characters most commonly employed, and although there is fairly general agreement that this is a useful guide, some investigators think that it is misleading. The real question is how far vitreousness is a guide to the quantity of gluten, and although an increase in the gluten content usually goes with increased vitreousness the rule is not infallible. Recently Greisenegger (Ref. 70) has studied some 500 varieties of spring and winter wheats grown under different conditions in Germany in an attempt to establish the connection between grain characters and baking quality. He found that the samples with the highest proportion of vitreous grains possessed the largest amounts of gluten, and that high gluten content was usually associated with good baking quality. He therefore considers that vitreousness is a guide to baking quality, whereas bushel weight is no guide. He adds that, under normal conditions, the colour, gloss and feel of the grain may be guides to baking quality. Most observers appear to agree that the bushel weight and the thousand-grain weight have a very slight, if any, relation with the baking quality, but Schnelle (Ref. 69) states that both these characters are of some value in indicating those differences in baking quality that are due to seasonal factors.

More recent references to laboratory tests of baking quality, and to methods which may be used by plant breeders, are given in Refs. 71–77, but, as has been pointed out by Quisenberry (Ref. 77) and others, the difficulty of the breeder is the lack of unanimity among cereal chemists as to which are the most important tests; moreover, the conceptions of a good quality wheat varies as between different parts of the world and even as between different millers in the same country.

The Research Association of British Flour Millers, which has undertaken the testing of the baking quality of home-grown wheats, has published interesting results on a large number of samples grown by the National Institute of Agricultural Botany (Ref. 78). Both named varieties and unnamed hybrids were included in the investigation, and besides comparing different stocks, the effects of manuring were studied. It was found that the protein content of the grain and flour was unaffected by the

extent of manuring (whether intensive or normal), but there was a definite increase due to intensive manuring compared with the ordinary management of the field trials. These differences were reflected in the dough and the bread.

Of the varieties tested, Holdfast was outstandingly the best in baking quality, with Yeoman II. second. Steel and Redman were of fair quality, while Square Head's Master was poor and unfit for breadmaking. April Bearded behaved peculiarly, being quite satisfactory in the early stages of the fermentation of the dough, but collapsing in the final stage and yielding a poor and almost uneatable loaf. The immediate cause was apparently the excessive leakage of gas through collapse of the gluten.

(*b*) Diseases.

The effect of environmental conditions on the resistance of wheat to yellow rust (*Puccinia glumarum*), which is the commonest rust disease of wheat in this country, has recently been studied in Germany and Canada. Newton and Johnson (Ref. 79) found that the germination of the rust spores, their longevity, and the development of spores on inoculated plants were materially affected by the temperature. Thus plants kept at 13°C. were susceptible to rust attack, but when the temperature was raised to 25°C., even for 12 hours a day, the plants became resistant. These authors conclude that the distribution of rust in Canada must be very greatly affected by this temperature sensitivity on the part of the rust fungus and its wheat host. A study of the resistance of 52 wheat varieties to four different forms of yellow rust showed that there were varieties possessing definite genetic factors for resistance; but because these four rust forms also attack some barley varieties and certain grasses, Newton and Johnson agree with other workers who have suggested that it is incorrect to divide *P. glumarum* into five varieties according to the host plant attacked.

Küderling, working in Germany, has shown that, under the conditions of his experiments, three types of wheat varieties could be distinguished according to their reaction to yellow rust at different temperatures. Of 17 varieties tested he found that some were attacked to the greatest extent at low temperatures; others were least attacked at low temperatures; while the third type appeared to be indifferent to temperature. But since the six races of the rust fungus investigated behaved differently with changes of temperature, the temperature relationships of rust infection are very complicated. Finally, Küderling also found evidence that the stage of development of some varieties affected the degree to which they became affected, with the result that there were varieties which were affected by temperature and development, varieties affected by one or other

of these factors, and varieties whose resistance was independent of both (Ref. 80).

A recent achievement in the production of a yellow-rust-resistant variety in India is described by Shaw and Pal in Ref. 81. This new form, designated Pusa 120, has arisen by hybridization between an Australian wheat called Federation and the variety Pusa 20. It shows resistance to all three of the strains of yellow rust found in India, and also to one of the two strains of brown rust. Unfortunately the variety sheds its grain when ripe, so that its principal use will be for further hybridization.

(c) Miscellaneous.

In this country most wheat is autumn or winter sown, and most of the varieties available to growers are what are loosely called "winter wheats." These winter wheats are relatively unsuccessful when sown in spring, although the variety Little Joss differs from most of the others in its ability to produce a satisfactory crop from very early spring sowings. In contrast to these winter wheats, there are the spring forms, such as April Bearded and Red Marvel, which are used for spring sowing only. True winter wheats possess cold-resistance and need, for their normal development, more or less exposure to cold. They also show a more prostrate habit in the early stages of growth. Müller (Ref. 82) has studied these characters in a wide range of wheat varieties and has found a more or less continuous series of types from pure winter to pure spring. His tests of winter hardiness showed that this was closely associated with the prostrate habit, and he was unable to find a true spring wheat with cold resistance. Nevertheless, genetical investigations showed that there was independent inheritance of cold resistance and low-temperature requirement (*i.e.*, the degree of "winterness"), although the two characters were so mutually related that the most winter-hardy types were those with the greatest cold resistance *and* cold requirement. On the other hand there seems to be nothing to prevent the production of a spring wheat (*i.e.*, one with no cold requirement) possessing also a high degree of cold resistance; in fact, hybridization between certain winter and spring forms has given spring forms with the full cold-resistance characters.

Besides pointing to the practically important possibility of producing cold-resistant spring wheats, which would be desirable under some conditions, this work shows how important it may be to analyze the complex physiological characters of plants before hybridization is attempted. This aspect of breeding work has been referred to in the previous section, and is of the utmost importance to all economic improvement work.

The tendency of the grain to sprout in the field after harvest

is a matter of some importance in parts of this country and in wet years. Although the farmer generally associates this character with the white wheats, recent work suggests that there is a more tangible association than this. Nikolaenko (Ref. 83) and Navolotskii and Navolotskaja (Ref. 84) have found that the greatest tendency to sprouting is found in wheat varieties from southern countries. Nikolaenko elaborates this point and asserts that the wheats which are most subject to sprouting are those which have a short period from ear emergence to maturity, and which are susceptible to the fungus *Fusarium rostratum* (wheat scab). Such varieties originated mostly in southern countries. Nikolaenko could find no confirmation of the view that white wheats are more prone to sprouting than red. This does not mean, of course, that the farmer is wrong. Experience has shown that the white sorts are more prone to sprout, but the connection is probably accidental. The cause of the tendency lies in the physiological habit of the plant.

In connection with the geographical origin of varieties, it is worth noticing that close study of varieties from various parts of the world has shown that it is possible to distinguish many different types according to their developmental characteristics. The life of the wheat plant is divided into various phases or stages, which are affected differentially by various factors of the environment. These phases also differ in length as between one type and another. Plant breeders are now selecting parents for hybridization with reference to the length and environmental relationships of these phases. By this means it is considered possible to combine in single plants any desirable succession of phases and thereby to breed varieties suited to any set of climatic conditions. A very large number of types usually results from crossing forms belonging to the same species but to distinct geographical races, and this type of crossing has many advantages over inter-specific hybridization. Some plant breeders feel very hopeful of its successful application to their particular problems (Refs. 85 and 86).

IV.—BARLEY.

(*a*) Breeding : Varieties : Quality.

The breeding of barley in this country is almost exclusively directed towards meeting the needs of the malting and brewing industry, and the varieties at present cultivated are, for the most part, two-row forms which can—given suitable growing conditions—produce grain suitable for malting and brewing. The importance of the market in determining the choice of variety may be seen from the fact that, for nearly a 100 years, the old Chevallier barley was grown for brewing purposes to the almost complete exclusion of other sorts ; Beaven has estimated

that for a considerable period of last century over 80 per cent. of the barley cultivated in this country was of this one variety (Ref. 87). Chevallier is little grown to-day, its place having been taken by the two comparatively new hybrids Spratt Archer and Plumage Archer; Chevallier, Archer, New Cross, Plumage, Goldthorpe and some other varieties are, of course, still grown, but only on small acreages.

The breeding of malting and brewing barleys is a very good example of the use of intensive or "close" methods, the characters which have to be considered being of a complex physiological nature and a good malting barley being a highly specialized type of plant. At present there seems little prospect of the successful application of wide crosses such as were discussed earlier in this article, and barley breeders, both in this country and in Sweden and Denmark (where a great deal has been done to improve malting quality), have concentrated on intensive methods. This means that the new and improved varieties are closely related, most of them having been obtained by selection and hybridization of old land forms. E. S. Beaven, who is one of the most experienced barley breeders in the world, gives it as his experience that it is "hopeless in practice to expect useful results from wide apart crosses even if each (parent) had some useful racial characters" (Ref. 88). Beaven's opinion is that the only useful method is to follow the purely empirical practice of successful animal breeders, and "select as parents those individuals which can claim an ancestry of proved economic worth and which are not very widely dissimilar in character." The success of these methods is largely dependent on the appearance in the progeny of a cross of a more valuable combination of characters than that possessed by either parent (transgressive segregation). The proof of the method is to be seen in the varieties Spratt Archer, Plumage Archer, Kenia, Maja and others.

A question of vital importance to the breeder and to the farmer is how far malting and brewing qualities in barley are varietal characteristics, and how far they can be influenced by external conditions such as weather, manuring and cultivations. There is no doubt that a given variety may be inherently a good, bad or an indifferent malting barley; but it is also true that external conditions can make or mar the malting sample. Growing conditions may override everything else, yet in the long run the inherent quality of the variety determines the value of the crop that can be produced on a particular farm. Obviously the most profitable variety to grow is the one which gives the highest yield of grain of the best malting and brewing barley; but one of the difficulties is to get a satisfactory definition and measure of malting quality.

At one time all barley was bought on hand valuation, but recent developments in malting and brewing research have altered this, so that barley can now also be judged on analysis. If hand valuation has its disadvantages, so has chemical and physical analysis, because an analysis regarded as ideal by one buyer may be somewhat different from the standard set by another. Different types of beer and different methods of brewing require barleys of different composition, while with the maltster who is producing malt extract for patent foods, etc., still another type of barley is in demand. Bishop, who is largely concerned with barley analysis in this country, states that the best criteria on which to judge varieties are the following (1) yield; (2) hand valuation; (3) the nitrogen percentage of the dry grain; (4) the thousand-grain weight; (5) yield of brewer's extract calculated on the weight of the raw barley; and (6) the amount of permanently soluble nitrogen in the beer wort (Ref. 89). Bishop gives a description of some of the well known varieties of barley in relation to these characters, and shows how some varieties fail in one character and some in another. He states that the best farmers' barleys for this country are the Archer hybrids—Spratt Archer, Plumage Archer and Golden Archer—but he considers that the ideal for some purposes would be reached by combining the high yield, good appearance and low nitrogen of these forms with the high extract yield and low wort nitrogen obtained from Kenia. In some cases, however, a high nitrogen content in the wort is desirable, and here it would be necessary to hybridize one of the Archer hybrids with Standwell, which is characterized by high wort nitrogen.

Although farmers, maltsters and brewers generally recognize the unsatisfactory results of assessing market values by hand valuations, the buyers are by no means convinced that chemical analysis can replace this hand valuation. Hopkins (Ref. 90) considers that analytical valuation is well on the way to reach an equal footing with hand valuation, but he admits that "before the value of barley to the brewer can be assessed adequately, it will be necessary to have further criteria wherewith to assess it." From analysis and laboratory experiments, Bishop considers that the cost of a quarter of barley often bears little relation to the cost of the malt, the lower-valued barleys giving a larger margin to the maltster than the higher-valued ones (Ref. 91). Bishop says that the buyer can say which of a number of barley samples will produce the best malt, but generally makes too great an allowance for the superiority of the highest quality samples. A study of the effect of the time of sowing on the quality of the malting sample showed that early sowing was better than late sowing, and that, even where sowing was late, it was more satisfactory to sow a variety with a long growing

season than an earlier maturing sort. Bishop considers, however, that further investigations on this question should be conducted in the North of England and Scotland, where the normal practice suggests that early ripening forms give the best results.

In order to overcome this unsatisfactory state of affairs in which hand valuation over-estimates the real value of the better barleys (because the competition forces up their market value), Bishop suggests a scheme of grading barley based on chemical analysis. If the true value of a barley were estimated by the potential yield of brewer's extract and the amount of soluble nitrogen, if the true value of malt were measured by the actual yield of extract and of soluble nitrogen, and if the extract were judged by colour, flavour, etc., then barley might be graded by its analysis. Bishop proposes a valuation scheme which is based on the above characters and gives a formula by which the extract value can be calculated (Ref. 92). He also suggests that the current practice, of using the most expensive barleys for all grades of beer, is wrong, and that if the high priced, low-nitrogen, barleys were used only for the most expensive high-gravity beers, then the supply would be nearer to the demand and excessive prices would not be necessary for the small amounts of first-class barley that are available. He pleads for a more enlightened use of the different grades of barley for the various types of beer, by which the higher-nitrogen barleys could be used for the manufacture of the cheaper, lower-gravity beers; and he argues that it has been proved that excess of soluble nitrogen in the wort does not lead to the bacterial instability which has been the bogey of brewers for many years.

The importance of all this to the barley grower must be obvious. If there were a steady demand for all grades of barley above a certain minimum standard there would tend to be a fairer price for all malting samples, although "fancy" prices would probably cease to be paid for barley of championship class. If malting barley prices could be based on the sort of analytical data suggested by Bishop, greater satisfaction would result to all concerned, and many of the prevalent discrepancies would be swept away.

(*b*) Six-Row Barleys.

Considerable amounts of six-row barley are imported into this country and are used by the brewer for mixing with the home-grown supplies of two-row sorts. The use of foreign six-row barleys for brewing in this country is comparatively recent—Beaven (Ref. 87) states that the practice increased rapidly from about the year 1886—but foreign two-row barleys have been imported for many years. The brewer says that the use of these

imported six-row barleys is necessary to ensure proper drainage in the mash tun, and also because, having been harvested under sunny, dry conditions, they have a beneficial effect on the quality of the beer. This " sun " in the barley is said to counteract the bad effects of the bad harvest conditions to which home-grown barley is often subjected (Butler, Ref. 93).

The tendency in recent years has been to import most of this six-row brewing barley from California, because of the consistent quality and the general suitability for brewing of Californian samples. Since the repeal of prohibition in America the internal consumption of barley has increased, and the supplies of Californian barley for export have shrunk considerably. Moreover, supplies of six-row barleys from other sources, such as Smyrna and Chile, have been curtailed and are uncertain as regards both their quality and quantity. For these reasons, and also because of the existence of reciprocal trade agreements, considerable apprehension is felt in this country concerning future supplies of six-row barley (Refs. 95 and 96). Not only is the supply of imported barley for brewing purposes under consideration, but a certain amount of interest is being shown in six-row barley for feeding purposes.

The question naturally arises as to whether or how far the farmers of this country could produce the necessary supplies of six-row barleys for brewing. The small amounts of six-row barley at present being grown in this country are unfit for brewing. If better varieties were available, these might meet the demands in good growing seasons, although there is always the uncertainty of the British climate to take into account. Most brewers contend that it is impossible to grow in this country the type of six-row barley which they require, but it must be said that the problem has never been seriously tackled. If drainage in the mash tun is still, despite modern equipment, a serious problem, it is quite possible for English-grown six-row barleys to satisfy this requirement; but the exact significance of the growing conditions in producing the right type of six-row barley is a more difficult matter that requires further investigation. Bishop admits that it would be difficult for us to compete with the low-water-content, and the general " condition " of imported barleys, but says that home-grown six-row barleys could quite possibly be utilized for some grades of beer (Ref. 89). There are six-row varieties available in this country which might supply various brewing needs, but as yet there is no demand for them by the brewer, nor, consequently, by the farmer. The problem of developing home-grown six-row barleys is one which the plant breeder and the farmer may shortly have to face, but it is difficult to forecast the immediate future in the light of the unstable world economic conditions.

A very useful bibliography (with abstracts of the more important papers) dealing with barley and barley malt up to the year 1935 is noted in Ref. 116. This publication, which is meant primarily for interested persons in the United States, deals with a number of subjects which are of interest to growers, maltsters, brewers and breeders in this country. It contains much information about the various types of barley used for malting, brewing, feeding and the manufacture of patent foods, and is of particular interest in relation to the problem of the supply of six-row barleys.

V.—OATS.

(a) Huskless Oats.

Interest in huskless oats was revived last year by the advertisement of stocks of seed of this type. From time to time the huskless oat is subject to no little notoriety, and extravagant claims are made about its agricultural and economic value. Although it is still cultivated in parts of China and survives on a very small scale in Ireland (where it is known as Pilcorn) its numerous introductions into this country have always failed. Biffen (Ref. 100) states that the searching investigation of the numerous types of huskless oats on the Continent and in the U.S.A. has failed to show that these have any economic value. Although it produces many grains per spikelet, this type of oat does not yield comparably with the normal husked oat, and hybridization experiments, conducted for many years, have failed to produce any forms of economic importance. This is probably another example of the failure of wide crosses in economic plant breeding.

The National Institute of Agricultural Botany conducted a series of six yield trials to compare the latest strain of huskless oats with Victory. The results showed that, even after deducting 28 per cent. from the yield of Victory to allow for the husk, the huskless oat was outyielded, on an average, by 42 per cent. (Ref. 101). It seems safe to assume that there is no immediate economic future for huskless oat cultivation in this country, and it is significant that a well known seeds firm has recently relinquished breeding work with this oat, after 40 years of effort.

(b) Varieties and the Level of Productivity.

Oats are grown in this country under a wider range of environmental conditions than any other cereal. Rainfall, altitude, soil type and level of fertility are all very variable factors which influence the choice of variety and the yields obtained. An attempt has been made in Wales to grade varieties according to their potential yields under different levels of

fertility (Ref. 102). The investigators have realized that it is not sufficient, in order to assess the relative yielding powers of varieties, merely to grow varieties under different conditions and take the average of the results obtained. This method may, in fact, be very misleading when the centres differ considerably in regard to the conditions mentioned above, because it takes no account of the suitability of particular varieties to particular conditions. It is, of course, true that, under moderately uniform conditions, a really good variety should always show its worth, but if there is anything at all in varietal adaptation, there should be limits to the conditions under which any one variety is supreme.

Grouping of the results of the Welsh trials has shown clearly that there are changes in the ranking of the varieties when these were grown under low-, medium- and high-cropping conditions. The general behaviour of the varieties in relation to level of productivity has been fairly well known for some years, and the aim of the present work is to obtain more precise data, by the use of which it may be possible, for example, to define the level of productivity at which a farmer should change from a variety in Grade I. to a variety in Grade II., etc. There are indications that, at levels below 15 or 18 cwt. of grain per acre, Grade I. varieties are outyielded by some members of the Grade II. or Grade III. groups. Moreover, complexities result from abnormal weather conditions during growth, and this matter must be investigated; occasionally it has been found that the seasonal effect may raise the productivity from a level where a Grade III. variety is the highest yielder to a level at which a Grade I. variety is best. Jones emphasizes the importance of not over-estimating the cropping capacity of any field because, where the produce is fed on the farm, a full crop of a lower-grade variety is likely to be of more value to the grower than a 75 per cent. crop of a Grade I. variety. On the other hand, under adverse conditions where it is difficult to obtain good germination and a full establishment of plants, seed treatment with mercuric dusts may enable a variety of higher grade to be grown.

From a survey of the sales of seed oats in 29 different centres throughout Wales it was found that approximately 53 per cent. of the seed belonged to Grade I. varieties (Victory, Abundance, Golden Rain, etc.); 40 per cent. to Grade II. (Scotch Potato, Castleton, Radnorshire Sprig and Black Tartarian), and 6 per cent. to Grade III. (Ceirch-du-bach and Ceirch Llwyd). It would thus appear to be very important for trials of oats in Wales to be so conducted as to distinguish between the widely differing sets of conditions. It would be useless to compare the behaviour of the different groups under the general average conditions of the country.

(c) Breeding.

In Ref. 103 is given a description of a new oat produced by the Welsh Plant Breeding Station, Aberystwyth. This variety —Ceirch Llwyd Cwta (S. 171)—is interesting as being one of the progeny of an interspecific cross, in which a form of *Avena strigosa* was hybridized with a plant of the species *Avena brevis.* The object of the hybridization was to produce an improved form of *Avena strigosa*, varieties of which are grown on the hill farms of Wales where the rainfall is high and the soil of low fertility. The great disadvantage of the forms hitherto grown is that the grain is heavily awned, and is therefore difficult to thresh and winnow. The new variety has given higher total yields (of grain and straw together) than the standard type of *A. strigosa* grown in Wales. The grain has a lower husk percentage, a higher thousand-grain weight and a higher bushel weight, is richer in protein and possesses a much reduced awn. The agricultural recommendations are that it should be grown under those conditions where the original *Strigosa* parent (Ceirch Llwyd) proved satisfactory, but it seems also to suit slightly better soils where a large bulk of fodder is required for winter feeding to stock.

An interesting account of the important problem of breeding oats resistant to frit-fly (*Oscinella frit* Linn.) attack is given by Cunliffe in Ref. 104. Crosses were made between resistant varieties from Sweden, Denmark and Gotland (named Spet, Hede and Sommar respectively) and varieties of good agricultural characters but possessing no resistance (Victory, Abundance, Star, King, etc.). Cunliffe's studies showed that resistance to frit-fly attack is inherited, but that there are annual variations in the degree of infestation which are inversely related to the temperature variations, while wet weather conditions during the flight of the fly limits the damage very markedly. Very careful analysis of the resistance properties, yield, thousand-grain weight, husk percentage and other agricultural characters, has enabled Cunliffe to isolate strains showing frit-fly resistance combined with desirable agricultural characters from crosses of Spet with Star, and of Spet with King. There was some suggestion that resistance to frit-fly attack in these investigations was associated with a high percentage of crude fibre and larger deposits of silica in the cell walls. Such characters would tend to increase the difficulty of larval penetration and therefore increase the resistance of the plants to attack.

VI.—HOPS: NEW VARIETIES.

Although they occupy only a small acreage, hops are a very valuable crop and a fair amount of work has been done, in this country, to provide the grower with improved varieties. The

economic value of a hop variety depends on its yield, its disease resistance and its richness in preservatives, and improvement in each of these characteristics has resulted from the breeding work at Wye College, Kent. Hops, like barley, have been developed in this country in recent years solely in relation to the demands of the brewing trade, and the growth of knowledge and discrimination has resulted in a reduction in the number of varieties. Amos (Ref. 97) states that the Fuggle variety is probably grown on 75 per cent. of the total hop acreage. This variety is particularly suited to heavier soils and does well in wet seasons, but it is gaining ground on the loamy soils, where Cobb's has of recent years superseded the choice "Goldings."

Four new varieties have been produced by Wye College recently (Refs. 98 and 99). Brewer's Gold is a variety which was raised by the selection of a seedling wild hop from Manitoba, and the area under this variety is extending. Quality Hop, Fillpocket and Brewer's Favourite are selections from an interspecific cross. The variety Oregon Cluster, which is very rich in preservative properties when grown in the United States but does not mature in this country, gave rise to a seedling from which in turn seed was gathered. Since the hop is a unisexual plant, the female Oregon Cluster plant must have been fertilized with the pollen of an English variety, and this seedling must again have been fertilized by the same or a different variety. Although the male parents are unknown in both cases, the selected seedlings must represent an interspecific cross, for Oregon Cluster belongs to the species *Humulus americanus*, whereas English hops all belong to the species *H. lupulus*.

Brewer's Favourite is being rapidly planted up, about 10 acres being in commercial cultivation, and 5,000 sets have been bought by growers. Quality Hop and Fillpocket are newer varieties; the former surpasses any English variety in preservative properties and has had satisfactory brewing trials; while the latter is a heavy cropping variety, is richer in preservative properties than the Fuggle, and has also behaved well in brewing trials. Nothing is as yet known of any particular suitability to soil types on the part of these two varieties.

Both varieties are carriers of "mosaic" disease and must therefore not be grown near to susceptible varieties; in common with Brewer's Favourite, they have so far shown no susceptibility to "Nettlehead" (previously known as the "eelworm disease"). These varieties should therefore prove of value for replanting Fuggle gardens which have become unproductive owing to attacks by this disease.

VII.—VARIETY TRIALS.

The results of trials conducted by the National Institute of Agricultural Botany have hitherto been published in the late

autumn, but the results of experiments conducted in the current year could not usually be included in these reports; it has, therefore, been decided for the future to publish in the early part of the year. This will avoid too great a lapse of time between the end of an investigation and the publication of the results and conclusions. In order to avoid any further time-lag, the current reports will be reviewed in this article in the year of their appearance. It is intended, in future, to include an account of these variety trials as a special section of this article. Full reports of the most recent trials will be found in Refs. 105 to 112.

(*a*) Sugar Beet.

Four separate trials of sugar beet strains or varieties are described by Armstrong in Ref. 105. The first included the seven strains: Kleinwanzleben E, Kleinwanzleben N, Dobrovice N, Dippe W.I., Kuhn P, Marsters' British Hilleshog and Johnson's Perfection, which were tested at each of the Institute's four centres from 1933 to 1935 (except Johnson's Perfection, which was tested only in 1934 and 1935). The second trial included the same varieties at one centre only (Selby, Yorks). The third trial included the five strains: Kleinwanzleben E, Delitzscher E, Danish 31-IV., Gostrup B and Schmidt A at each of the Institute's four centres; while the fourth trial was to test the three strains—Kuhn E., Dobrovice N and Marsters' British Hilleshog—on a fen soil.

The chief object of the first main trial was to test the suitability of the strains to early lifting, and detailed information was obtained concerning bolting propensities, weight and shape of individual roots, yield of roots, yield of sugar per acre and cash value. The results showed that Kleinwanzleben E gave the highest yields of sugar and the greatest cash value per acre, even with early lifting. Kleinwanzleben N was, on the average, second to Kleinwanzleben E in weight per root and in yield per acre of roots and sugar, while it was equal second, with Marsters' British Hilleshog and Johnson's Perfection, in cash value per acre. Kuhn P and Dobrovice N came next in cash value, while Dippe W.I. was the least remunerative variety, giving a value of £2 per acre less than Kleinwanzleben E. It should be noted that Dippe W.I. showed the greatest tendency to bolt (2·31 per cent.), Dobrovice N being second with 1·66 per cent. bolters, and the remaining five strains having less than 1·0 per cent. Marster's British Hilleshog gave the lowest figure of 0·11 per cent.

In the second trial at Selby with the same strains there was approximately the same difference in cash value per acre between the most remunerative strain (Kleinwanzleben E) and the least remunerative strain (Dippe W.I.), but the positions of the

intermediate varieties were changed. It is interesting that in the 1935 trial at Selby, Kleinwanzleben E gave the lowest weight per root of any variety, whereas this strain usually leads in this respect.

In the one year's trial on fen land at Littleport, between the strains Kuhn E, Dobrovice N and Marsters' British Hilleshog, the last named showed a clear superiority in yield of roots and yield of sugar per acre, although perhaps it should be mentioned that the number of roots per acre of Dobrovice N was below the average. The tops of Marsters' British Hilleshog were the smallest and were very uniform, although they showed some signs of yellowing at lifting time.

In the supplementary trials of Kleinwanzleben E, Delitzscher E, Danish 31-IV., Glostrup B and Schmidt A at the four centres occupied by the main trials, the first named strain gave the highest average yield of sugar per acre and the greatest cash value. On the other hand, Schmidt A was outyielded by Kleinwanzleben E only on three occasions, and the general average of the former was not much inferior.

The general conclusions from these trials are as follows: Kleinwanzleben E continues to be the most remunerative strain on a wide range of soils. It is a good variety for early sowing and comparatively early lifting, yet it gives the best returns for normal or late lifting. There seems to be little to choose between the other strains included in the main trials. They are all good, and in the Foreword of the Institute's *Journal* special mention is made of the continued and unchanged high standard of the strains, in spite of the difficulties in raising pure stocks of seed in a cross-pollinated crop such as sugar beet. The greater tendency of Dippe W.I. and Dobrovice N to bolt, and their consequent unsuitability for early sowing, should be mentioned. Marsters' British Hilleshog, on the other hand, is a low-bolting strain particularly suited for early sowing. There seems to be nothing outstanding in the strains Schmidt A, Glostrup B, Delitzscher E and Danish 31-IV. They all approximate to the "E" type, have roots of good shape, are resistant to bolting and are suitable for comparatively late lifting.

(*b*) Spring Oats.

The results of spring oat trials from 1932 to 1935 are described by Thompson in Ref. 106. Nine centres were included, although not all the varieties were grown at each, nor were all the centres represented in each of the four years. The varieties tested were Marvellous, Eagle, Resistance, Progress, Glasnevin Success No. 3, Glasnevin Sonas, Onward, Potato and the unnamed hybrids 236/5, 236/29 and S. 84. In all cases these varieties were tested against Victory as the standard. From the plant breeding

point of view, and in the light of what has been said previously in this article, it is interesting to observe that six of the forms tested—Eagle, Progress, Glasnevin Success No. 3, 236/5, 236/29 and S. 84—are hybrids with Victory as one of the parents.

The behaviour of each named variety at the various centres cannot be discussed, but reference will be made to the general averages of the results obtained. This method of comparison does not take into consideration any special suitability of the varieties for special conditions, but it does give some idea of the relative order of merit. Eagle and Glasnevin Success No. 3 were the only varieties to give, on the average, a higher yield of grain than Victory. Resistance was approximately equal to Victory. Marvellous and Progress were both inferior in grain yield to Victory, the latter variety giving the lower average of the two. No variety excelled Victory in yield of straw; Progress and Eagle were only slightly inferior, while the other three varieties were considerably lower. The variety Onward was included only in the 1935 trials, but the results tend to show that this variety is higher yielding than Victory. Total yield of grain is, of course, not the only factor to be considered in assessing the value of a variety of oats, and the trials also give data for the husk percentages and for the market values of the grain. The husk percentage, of course, gives the yield of kernel and is a measure of the feeding value, but it is very important to note that the feeding value of a sample bears little relation to the price which would be paid for it on the open market. Thus although a variety like Onward has a high percentage of husk, it commands a high price; while Eagle, which has a lower husk percentage, suffers in cash value because of the small size of its grain. The same trend may be seen for the two autumn-sown oats Resistance[1] and Marvellous, the former having a higher yield of better quality grain than the latter, but being lower in cash value. There appears to be little justification for the discrepancy, but so long as there is a preference for a large, white, plump grain it is necessary for the grower, if he is growing for sale, to study the preference.

The trials may therefore be summarized as follows: From its limited trials, Onward promises to be a most profitable variety to grow for sale, while Eagle is strongly recommended for every other purpose. Marvellous and Resistance may be sown either in spring or autumn and are specially recommended where there is a tendency to serious lodging. Resistance is stronger strawed than Marvellous, and gives a higher yield of grain, but the grain is of lower market value. The trials did not show any particular advantage in growing Glasnevin Sonas,

[1] Resistance, of course, is not a spring oat. This trial is therefore not a true criterion of its potentialities.

Progress or Glasnevin Success No. 3, although the last named variety yielded somewhat better and was valued a little higher than Victory. The lower husk percentage of Victory, however, compensates for its lower yield, but if oats are grown for sale Onward is probably to be preferred.

The county spring-oat variety trials give the yields of Eagle, Golden Rain II., Progress and Star at 56 different centres in England and Wales (Ref. 107). Taking England as a whole, Eagle was the heaviest yielding variety, although the differences between this variety and Star were small in all districts, and in the Southern counties the latter variety was actually the higher yielder. The lowest yielding variety was Progress, while Golden Rain II. occupied an intermediate position between this variety and Star or Eagle. Thus, although the relative positions of the varieties show a certain amount of variation in the various counties, it is significant that either Eagle or Star was the heaviest yielder in 20 out of the 26 counties, and Progress was the lowest yielder in 16 counties. The values of the grain of these four varieties were very similar, although there was some suggestion that Star possessed the most desirable type of grain. The results of these county trials should be noted by farmers, and where possible details of the behaviour of the tested varieties should be ascertained from the county staffs. It is only by repeated trials of this nature that the most desirable varieties for local requirements can be discovered.

(c) Potatoes.

A summary of the work of the Lord Derby Gold Medal Committee from 1915 to 1936 is given by Bryan in Ref. 108. Bryan states that "a Gold Medal award should be looked upon as an indication that the Committee regard the varieties as being likely either to satisfy requirements left unsatisfied by those already established in public favour, or which show signs of superiority in one direction or another over varieties at present in cultivation." It is, of course, realized that the short trials to which the varieties are subjected cannot take into consideration the behaviour of the varieties towards virus disease. In many ways this is a serious defect of the trials, because the future of a variety depends very much on its reaction to viruses. Nevertheless, the value of the Committee's judgment may be assessed by the success of those varieties which have received awards. Between 1925 and 1936, 48 varieties were tested and 11 awards have been made, and it is significant that, during this period, and with the single exception of Doon Star, no new variety other than those which have received awards has become a successful commercial variety. The varieties which have received awards are Arran Consul, Arran Banner, Arran Crest, Arran Cairn, Doon Pearl,

Arran Signet, Gladstone, Doon Early, Redskin and Dunbar Standard. The last three varieties received awards in the 1936 trials, and it may be worth while to mention briefly their apparent merits (Ref. 109). Doon Early is a first early with oval, white-skinned and white-fleshed tubers and medium to deep eyes. It possesses the very valuable character for a first early of bulking at least a week earlier than Epicure, while in these trials the tubers were larger, more uniform and of a better cooking quality than those of the latter variety. Redskin and Dunbar Standard are both main-crop varieties. The former possesses round, shallow-eyed, pink-skinned and white to pale-yellow-flushed tubers, and the latter's tubers are oval to kidney shape with white flesh and skin, and shallow eyes. In the trials Redskin was superior to Kerr's Pink and did not show the latter's proneness to secondary growth, while its cooking quality was satisfactory. Dunbar Standard appeared to possess a cooking quality equal to King Edward, while the yield and shape of tubers were particularly impressive.

The effects of seed tuber size and origin on total yield and on yield of ware are described in Refs. 110 and 111. In the trial on the effect of seed tuber size, the variety Kerr's Pink was used. Five classes of seed tuber were employed—large halved (3 oz.), medium (2 oz.), small (1 oz.), medium halved (1 oz.) and large quartered (1½ oz.). The results showed that the large halved seed tubers gave the highest yield of ware, but the whole tubers weighing 2 oz. were a close second. The differences in yield became less marked as the size of the riddle, over which the ware was dressed, was increased, because the large halved and medium whole tubers produced a smaller percentage of large ware than did the other sizes. This factor tends to reduce the yields of the largest grade of ware to a uniform level, and cash differences in the returns were correspondingly small, although the large and medium halved seed tubers did give the highest profit except where a 1⅞ inch riddle was used. In this case the large halved seed tubers gave a lower return than the small halved and the large quartered.

The trial with seed tubers of various origins, the variety being Majestic, was planned to test some of the stocks grown under the special conditions laid down by the Ministry of Agriculture for the production of Class I. (special stock) seed. The stocks were Scottish, Irish Free State, Northern Irish, Welsh, Cumberland, and Isle of Man. It should be noted that the trial crops failed to mature properly, owing to an attack of late blight. As far as could be ascertained all the stocks were affected to the same degree, and only occasional tubers were infected at lifting. The total yields of sound ware showed a superiority for the Scottish and Irish Free State seed tubers, but there were a number of

gaps in the Welsh and Isle of Man plots, which were probably responsible for reduced yields from both of these stocks, particularly the latter. The Scottish, Irish, Welsh and Cumberland stocks were apparently free from virus infection, but the Isle of Man stock showed a 2·0 per cent. infection with secondary leaf roll and a 3·3 per cent. infection with severe mosaic.

The significance of healthy seed is dealt with briefly by Bryan (Ref. 111), who points out that although approximately 500,000 acres of potatoes are grown in England and Wales, the seed imported each year from Scotland and Ireland is sufficient to plant only about 120,000 acres. This does not necessarily mean that the remaining 380,000 acres are planted with virus-infected stock, but it has meant, until the recent scheme for Class I. stock came into force, that most of this area has been planted with stocks of unknown health. Bryan describes a method whereby stocks may be kept free from virus when grown in England. The stock must be isolated at least 60 yards from other potatoes and if doubtfully healthy plants are noticed they must be pulled out at an early stage. It is essential also that the land sown to such stock should contain no tubers left over from a previous crop. In this way it should be possible for small growers to raise their own supplies of healthy tubers from year to year, and the plan would be a definite improvement on the rather haphazard methods employed over a larger potato acreage.

Other potato trials reported for 1936 include the following straightforward varietal tests. Gladstone (which was awarded a Lord Derby Gold Medal in 1935) gave a higher percentage of ware than King Edward at Ormskirk, the individual tubers being larger and of a better shape than those of the latter variety. The tubers of Gladstone were, however, hollow in the centre, but it is hoped that this may prove to have been merely a seasonal effect. There was also a suggestion that at Ormskirk Gladstone was more resistant to late blight than King Edward, but in further trials at Southery, on fen soil, it was found that, although the former variety showed resistance to blight infection of the tops, the tubers were severely infected. In this trial at Southery, Gladstone and Duke of Kent outyielded King Edward, Majestic, Doon Pearl, Doon Star, Arran Peak and Mons Star (which is a synonym of King Edward). At Kirton (Lindsey), Majestic, Duke of Kent and Gladstone outyielded Doon Star and Arran Peak, which in turn outyielded King Edward. In both these latter trials the incidence of blight was so heavy that the actual yields obtained cannot be regarded as a true measure of cropping capacities, and it is significant that at Kirton Gladstone again had the highest percentage of blighted tubers.

Finally in Ref. 112 an account is given of the cooking qualities

of King Edward and Majestic when grown on five different soil types—Dunbar red sandstone, Oolitic limestone, medium heavy silt, light sandy loam and black fen. It was impossible from these trials to disentangle the various factors affecting the cooking quality, or even to say how far weather conditions may have masked the influence of the soil, but it should be noted that the best and most consistent quality was obtained in the tubers grown on the Dunbar red sandstone. This centre also showed the least variation in weather conditions. But it is also significant that there was a striking difference in the quality of the tubers grown on fen soil in 1935 and 1936, and that, in the former year, the quality of the samples from this soil was generally equal to that from the Dunbar red sandstone. There were no great differences between the quality of the two varieties, but for the most part King Edward was superior to Majestic in the tests used for assessing suitability for frying and steaming.

VIII.—GENERAL PATHOLOGY.

An interesting paper by Brooks (Ref. 113) deals with many general aspects of plant diseases and methods of control. He mentions some of the more important control methods, such as the breeding of disease-resistant forms, improved "plant sanitation" or "hygiene" and the use of chemicals for spraying and seed treatment. Brooks refers to the great attention which is now being paid to the relationship between the host and the parasite, and states that more care is now bestowed on the growing plant in an endeavour to favour it at the expense of the parasite. But it is not by any means universally true that plants which are growing most vigorously under the best possible environment are least susceptible to parasite attacks. The effects of temperature, and of the stage of development of the plant, on the incidence of yellow rust have been mentioned above in the section on wheat, and there are many cases (*e.g.*, downy mildews and rusts) where the parasites thrive best when the hosts are most vigorous. Brooks states that there may be some truth in the statement that more vigorous plants are less liable to attack by organisms which are weak parasites.

A very important aspect of pathological work, from the agricultural point of view, is the source of infection of those diseases which regularly infect crops from year to year, and the means by which these diseases are disseminated. In black stem rust of wheat (*Puccinia graminis*) these important points have been more or less completely elucidated in Canada, the United States and India. In this country it has been found that the only two rust diseases which occur to any extent—yellow rust (*Puccinia glumarum*) and brown rust (*Puccinia triticina*)—over-winter in the summer-spore stage, so that no alternate host

seems to be necessary for their survival. Investigations of these diseases in this country have also demonstrated several physiological forms which have not been described from any other country. It seems to be definitely established that such new physiological forms are constantly arising by hybridization and mutation (" sporting "), so that breeding for resistance to diseases caused by such fungi becomes a matter for continuous local investigation.

Intensive study of the micro-organisms which cause disease has shown that they may have fundamental effects on one another, so that a host attacked by one micro-organism may become more susceptible to the attacks of another. For example, infection by bunt (*Tilletia Caries*) appears to break down the resistance of certain varieties of wheat to yellow rust, while an attack of mildew (*Erysiphe graminis*) induces susceptibility to brown rust in wheat varieties which are normally resistant to the latter disease. It is also known that infection of certain potato varieties by virus diseases has led to a greater susceptibility to late blight (*Phytophthora infestans*). On the other hand, there is sometimes a considerable degree of antagonism between types of micro-organisms, and it has been shown in several cases that the non-parasitic micro-organisms in the soil may have very marked effects on the incidence of certain soil-borne diseases. The significance of this in relation to attacks by "take-all" (*Ophiobolus graminis*) was referred to in the previous article of this series, and there are evidently similar phenomena in other soil-borne organisms causing " foot rot " diseases of cereals, and such diseases as potato scab (*Actinomyces scabies*) and " damping off " of seedlings caused by *Rhizoctonia Solani*. When the relationships have been fully studied they may offer interesting methods of biological control for certain diseases.

Stakman (Ref. 114), in a general article on the specialization of fungi causing plant diseases, draws attention to the great significance of this specialization (which has resulted in the production of physiologic forms) in relation to the study of epidemics of plant disease. This may be seen when the climatic conditions favour the growth of particular strains at the expense of others, so that different strains may be the most prevalent in different years and the incidence of disease will depend on the resistance or susceptibility to the strains that happen to prevail. Stakman also discusses the importance of the constant supply of new strains of certain plant diseases by hybridization, and suggests that in certain cases (*e.g.*, stem rusts and crown rust of oats) the eradication of the non-economic host on which hybridization occurs would help to prevent the development of new races and would tend to reduce the number already in existence. This, of course, would have no effect on the production

of new strains by mutation or "sports," but there is evidence that at least in certain cases (*e.g.*, the rust fungi) the occurrence of mutations is rare.

IX.—WEED ERADICATION.

An account of the use of chemicals for the eradication of weeds was given in the last issue of the *Farmer's Guide*. In this particular attention was paid to the control of perennial weeds by killing the subterranean parts of the plant. A recent account of experiments by Blackman and Templeman deals particularly with the eradication of annual weeds in cereal crops, and reference to this work completes a general review of the use of chemicals for keeping the land clean (Ref. 115).

The chemicals were applied as a spray by means of knapsack equipment at the rate of 100 gallons per acre. In all cases the weeds were treated in the seedling stage, and the efficacy of the sprays was measured by counting the density of the weeds before and after spraying. Effectiveness in the control of the three species—charlock (*Brassica arvensis*), jointed charlock or runch (*Raphanus raphanistrum*) and field poppy (*Papaver rhœas*) depended primarily on the quantity of acid remaining in contact with the leaf tissues. The amount of spray necessary to kill the plants varied with the species and, since the epidermis of the leaf possesses no thickening or waxy covering, the addition of a wetter to the spray had little effect except in cases where the weeds were so thick that the leaves overlapped. In such cases the addition of Agral was found to add to the killing power of the spray. With charlock a 90 per cent. control was obtained with 9·2 per cent. solution of sulphuric acid, while nitric acid at equivalent concentrations was more effective in some cases. Ammonium hydrogen sulphate (21·6 per cent. solution) and sodium hydrogen sulphate (23·6 per cent. solution) gave results practically as satisfactory as sulphuric acid, but ammonium thiocyanate (3–10 per cent. solutions) was not as efficient. With runch a 95 per cent. control was obtained with sulphuric acid (13·8 per cent. solution) and, as in the case of charlock, nitric acid at equivalent concentrations was more effective in some cases. Neither ammonium nor sodium hydrogen sulphate, nor ammonium thiocyanate was as effective as acid for this weed. Effective control of field poppy was obtained only when it was sprayed in the youngest stages, because its resistance to the sprays increases as it grows older. 90 per cent. control resulted from the use of a stronger (18·4 per cent.) solution of sulphuric acid than was necessary for the two previous species, and in some cases the use of a wetter improved the kill.

Corn marigold (*Chrysanthemum segetum*), stinking mayweed (*Anthemis cotula*) and shepherd's needle (*Scandix Pecten-Veneris*)

were more difficult to control. Corn marigold was effectively controlled by 13·8 to 18·4 per cent. solutions of sulphuric acid only when a wetter (Agral) was added to the spray; the reason being that this weed has a superficial covering of wax. Stinking mayweed needed higher concentrations of sulphuric acid, but satisfactory control was given by a 27·6 per cent. solution, particularly when Agral was incorporated in it. Only one experiment was conducted with shepherd's needle, and the plants were several inches high, but only a partial control was achieved with a 27·6 per cent. solution of sulphuric acid including Agral.

Controlling the various weeds gave varying effects on the yield of the cereal crops; in some cases there was no increase whatsoever, while in other cases there were increases going up to 227 per cent.; the size of the yield increase bore no relation to the density of the weed population. Suppression of charlock increased the yield in only two out of the seven experiments, but it should be noted that in no case was the weed population high. On the other hand, although the plant population of poppy was very high, an increase in crop yield was obtained in only one out of five experiments. The small number of experiments conducted with the other weeds pointed to an increase in crop yield with suppression of the weeds. There was no evidence to suggest that nitric acid was in any way more effective than sulphuric acid in increasing the crop yield, and there is some danger with the former of adding too much nitrogen, which may cause lodging or may impair the malting quality of barley.

In some experiments both nitric acid and sulphuric acid injured the crop and caused a decrease in yield. The damage was large in only one experiment, but wherever it occurred the spraying had been carried out in exceptionally dry weather. The cause of the damage appears to be merely an exaggeration of the check to growth which is caused by the spray even in a normal year.

The investigators conclude that the order of increase in yield of the cereal crop due to spraying is dependent on the weed species but is not directly associated with the density of the weed population. Similarly, the order of decrease in yield of the crop caused by allowing the weeds to remain undisturbed, is not directly correlated with the competition for light and nitrogen; but the particular weed species and the weather conditions in May and early June must also be considered.

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References.

1. Crops and plant breeding. *Jour. Roy. Agric. Soc. England*, **97**, 1936.
2. Stapledon, R. G., Thomas, M. T., and Milton, W. E. J. Investigations on the improvement of hill grazings. *Welsh Pl. Breed. Stn. Bull. Ser. H.*, 14, 1936.
3. Stapledon, R. G. The improvement of hill land. *Scot. Jour. Agric.*, **19**, 1936.
4. Fenton, E. Wyllie. The problem of moor mat grass. *Scot. Jour. Agric.*, **19**, 1936.
5. Wilson, A. S. B. The improvement of rough hill pasture by cattle grazing. *Scot. Jour. Agric.*, **19**, 1936.
6. Jones, Ll. Iorwerth. Pasture management and its effect on the sward. Part III. A poor *Agrostis* pasture. *Welsh Jour. Agric.*, **12**, 1936.
7. Blackman, G. E. The influence of temperature and available nitrogen supply on the growth of pasture in the spring. *Jour. Agric. Sci.*, **26**, 1936.
8. Lewis, A. H. The effects of ammonium and nitrate nitrogen on the growth of perennial ryegrass. *Jour. Agric. Sci.*, **26**, 1936.
9. Caldwell, J., and Richardson, H. L. The growth of clovers in the presence of ammonium sulphate. *Jour. Agric. Sci.*, **26**, 1936.
10. Roberts, R. Alun, and Hunt, I. V. The effect of shoot cutting on the growth of root and shoot of perennial ryegrass (*Lolium perenne* L.) and of timothy (*Phleum pratense* L.). *Welsh Jour. Agric.*, **12**, 1936.
11. Osvald, H. Manuring of Swedish meadowland. *Herb. Revs.*, Nos. 1–2, **4**, 1936. (Article review by R. Peter Jones.)
12. Notes from agricultural colleges : Craibstone. *Scot. Jour. Agric.*, **19**, 1936.
13. Jones, Ll. I. The feeding value of pastures sown with different strains of grasses and clovers. *Emp. Jour. Exp. Agric.*, **4**, 1936.
14. Kirk, L. E. Forage crop improvement in western Canada for dryland agriculture. *Emp. Jour. Exp. Agric.*, **4**, 1936.
15. Raymond, L. C. Pasture studies, VIII. Improvement of grazing lands in eastern Canada. *Emp. Jour. Exp. Agric.*, **4**, 1936.
16. Ullmann, W. Natural and artificial hybridization of grass species and genera. *Herb. Revs.*, Vol. 4, No. 4, 1936.
17. Moodie, A. W. S. Pasture strains : their significance in improvement work. *Agric. Gaz. New South Wales*, XLVII., Pt. 2, pp. 82–84, and Pt. 3, pp. 129–32, 1936.
18. Virtanen, Artturi I., and Manne Nurmia. Studies on the winter hardiness of clover. I. The effect of cutting on the carbohydrate reserve in red clover roots. *Jour. Agric. Sci.*, **26**, 1936.
19. Brandes, E. W. The origin and improvement of sugar cane. *U.S. Dept. Agric. Yr. Bk.*, pp. 561–623, 1936.
20. Sugar cane breeding in the West Indies. *Inter. Sug. Jour.*, pp. 125–8, 1936.
21. Bell, Arthur F. The breeding of new varieties of sugar cane. *Cane Grow. Quart. Bull.*, **3**, 1936.
22. Ammal, Janakie K., and Singh, T. S. N. A preliminary note on a new *Saccharum* × *Sorghum* hybrid. *Indian Jour. Agric. Sci.*, **6**, 1936.

23. Williams, B., Cameron, C., and Holman, C. Fertile sugar cane × millet hybrids. *Nature, Lond.* **137**, p. 830, 1936.

24. Veruschkine, S. M. The main line of work with *Triticum-Agropyrum* hybrids at the Saratov Station. *Breeding and Seed Growing*[1], No. 8, 1936.

25. Veruschkine, S. M. The prospects of hybridizing wheat with *Agropyrum*. *Breeding and Seed Growing*, No. 2, 1936.

26. Deržavin, A. I. Breeding perennial varieties of wheat and other plants. *Breeding and Seed Growing*, No. 9, 1936.

•27. Deržavin, A. I. The problem of perenniality in agricultural plants. *Breeding and Seed Growing*, No. 5, 1936.

28. Tzitzin, N. V. My experiments on wheat. *Breeding and Seed Growing*, No. 3/11, 1935.

29. Tzitzin, N. V. The problem of perennial wheat. *Breeding and Seed Growing*, No. 2, 1936.

30. Tzitzin, N. V. What we are working on. *Breeding and Seed Growing*, No. 5, 1936.

31. Cicin, N. V. The problem of perennial wheat. *Breeding and Seed Growing*, No. 2, 1936.

32. Šibaev, P. M. The quality of the grain in *Agropyrum* and *Triticum-Agropyrum* hybrids. *Breeding and Seed Growing*, No. 6, 1936.

33. Khiznjak, V. A. Cytological study of *Triticum-Agropyrum* hybrids and the method of breeding perennial wheat. *Proc. Azov.-Black Sea Selection Centre*, Issue I., 1936.

34. Katterman, G. Position and prospects of wheat-rye hybridization. *Praktische Blätter für Pflanzenbau und Pflanzenschutz*, **14**, 1936.

35. Katterman, G. Genetic results with wheat × rye hybrids up to F_4. Pt. II. *Pflanzenbau*, **13**, 1936.

36. Katterman, G. Results on the double fertilization of F_1 wheat-rye hybrids. *Züchter*, **9**, 1937.

37. Meister, N. G. Rye-wheat hybrids and their importance in breeding. *Breeding and Seed Growing*, No. 2, 1936.

38. Meister, G. K. On what we are working. *Breeding and Seed Growing*, No. 6, 1936.

39. Čanov, T. V. The rye-wheat hybrid 46–131 in the Šatkov region. *Breeding and Seed Growing*, No. 6, 1936.

40. Vakar, B. A. New triplicate wheat hybrids. *Züchter*, **8**, 1936.

41. Percival, J. *Ægilotriticum ovata-turgidum*: a fertile species hybrid. *Ann. Bot. Lond.*, **50**, 1936.

42. Clark, J. Allen. Improvement in wheat. *U.S. Dept. Agric. Yr. Bk.*, pp. 207–302, 1936.

43. Waldron, L. R., and Clark, J. A. Breeding rust resistant spring wheats. *Science*, **83**, 1936.

•44. The South American potatoes and their breeding value. *Imp. Bur. Pl. Genetics, Cambridge*, 1936.

45. Survey of the work of the Agricultural Departments, University College of Wales, Aberystwyth, Oct., 1936.

46. Müntzing, A. Report on the activities of the Swedish Seed Union's Cytological Dept., during the period 1st Oct., 1931—30th Sept., 1935. *Sveriges Utsädesforeningens Tidskrift*, **45**, 1933.

[1] Translation of title of Russian Journal—*Selektsija i Semenovodstvo.*

47. Lehmann, H. On interspecific cross sterility in the genus *Nicotiana*. *Zeitschrift fur Induktive Abstammungs und Vererbungslehre*, **72**, 1936.

•48. Eghis, S. A. Interspecific hybridization in *Nicotiana*. IV. *Bull. Appl. Bot. Leningrad*, 1935, Ser. II. (9), 1936.

49. The genetics, breeding and seed production of cotton. *Sredaz NIHI, Central Breeding Station, published Sel'khozgiz, Moscow and Leningrad*, 1933.

50. Lubenec. New varieties of lucerne and sainfoin. *Breeding and Seed Growing*, No. 5, 1936.

•51. The experimental production of haploids and polyploids. *Imp. Bur. Pl. Genetics, Cambridge*, October, 1936.

•52. Garner, W. W. Superior germ plasm in tobacco. *U.S. Dept. Agric. Yearbook*, p. 785, 1936.

53. Jenkins, Merle T. Corn improvement. *U.S. Dept. Agric. Yearbook*, p. 455, 1936.

•54. Coons, G. H. Improvement of sugar beet. *U.S. Dept. Agric. Yearbook*, p. 625, 1936.

•55. Lysenko, T. D. Intra-varietal crossing of self-pollinated plants. *Socialistic Reconstruction of Agriculture*, **10**, 1936.

•56. Bell, G. D. H. The art and science of plant breeding. *Agric. Progress*, XIV., 1937.

•57. Hurst, C. C. Recent work in plant breeding. *Emp. Cott. Grow. Rev.*, **13**, 1936.

•58. Ramiah, K. Recent advances in plant breeding. *Agric. Live-Stk., India*, **6**, 1936.

59. Sengbusch, R. v. Chemistry and plant breeding. *Forschungsdienst* 1, *Sonderheft* 2, 1936.

60. Sengbusch, R. v. A problem in research in breeding. The analysis and synthesis of complex characters. *Forschungen und Fortschritte*, **11**, 1935.

61. Meister, G. K. Some critical remarks. *Breeding and Seed Growing*, 2/10, 1935.

62. Lysenko, T. D. Reply to the article "Some Critical Remarks." *Breeding and Seed Growing*, 2/10, 1935.

63. Watkins, A. E. The practical application of genetical science to plant breeding. *Rep. 2nd Congr. Emp. Cott. Corp.*, 1934.

64. Hutchinson, J. B., and Kubersingh. Studies in plant breeding technique. I. An analysis of the efficiency of selection methods used in improvement of Malvi cotton. *Indian Jour. Agric. Sci.*, **6**, 1936.

65. Smith, H. F. A discriminant function for plant selection. *Ann. Eugen., Camb.*, **7**, 1937.

66. Phipps, I. F. Recent developments in genetics and plant breeding. *Jour. Austral. Inst. Agric. Sci.*, Vol. 2, 1936.

•67. Miles, L. G. Back-crossing and its use in plant breeding. *Jour. Austral. Inst. Agric. Sci.*, Vol. 1, 1935.

•68. Report of the International Congress of Plant Breeders (Netherlands), 1936. Edited by M. P. Sirks, publ. by E. J. Brill, Leiden.

69. Bibliography of baking quality tests. *Imp. Bur. Plant Genetics, Cambridge*, Jan., 1934.

70. Greisenegger, I. K. The characters of wheat and their mutual relationship. *Pflanzenbau*, **13**, 1936.

71. Šibaev, P. N. Variation in the baking quality of wheats in hybridization. *Breeding and Seed Growing*, No. 1, 1936.

72. Lindberg, J. E., and Kajmer, H. On the determination of quality in wheat. *Züchter*, **8**, 1936.

73. Mueller, G. The present position of flour quality determination by physical methods. *Zeitschrift für das gesamte Getreidewesen*, **23**, 1936.

74. Schribaux. Methods of testing wheat quality. *Compte rendu des séances de l'Académie d'Agriculture de France*, **22**, 1936.

75. Bœuf and Matweeff, M. Obserations on the testing of wheat by the Extensimeter (Chopin's method), variability due to technique (conclusions). *Compte rendu des séances de l'Académie d'Agriculture de France*, **22**, 1936.

76. Miège, E. On the Pelschenke Method (conclusions). *Compte rendu des séances de l'Académie d'Agriculture de France*, **22**, 1936.

77. Quisenberry, K. S. Developing and testing improved varieties of wheat. *Cereal Chem.*, **13**, 1936.

78. Fisher, E. A. The quality for breadmaking purposes of wheats harvested in 1935. *Jour. Nat. Inst. Agric. Bot.*, IV., 1937.

79. Newton, M., and Johnson, T. Stripe rust, *Puccinia glumarum*, in Canada. *Canad. Jour. Res.*, **14** C., 1936.

80. Küderling, O. E. Investigations on the field resistance of individual wheat varieties to *P. glumarum tritici*. *Zeitschrift für Züchtung*, A. 21, 1936.

81. Shaw, F. J. F., and Pal, B. P. Pusa 120 : a wheat highly resistant to yellow rust. *Agric. Live Stock in India*, **6**, 1936.

82. Müller, K. O. Information on the spring-winter type in *T. vulgare* on the basis of genetical investigations on Anatolian soft wheats. (Preliminary Notes.) *Angewandte Botanik*, **18**, 1936.

83. Nikolaenko, E. I. Sprouting of the grain in spring and winter wheats of the world collection at Detskoe Selo. *Bull. Appl. Bot. Leningrad*, Ser. A. (16), 1935.

84. Navolotskii, A. V., and Navolotskaja, N. M. Breeding spring wheats to raise the germination capacity of the grain. *Breeding and Seed Growing*, No. 9, 1936.

85. Kostjučenko, I. A., and Kalinin, P. K. Prospects of breeding wheat in the conditions of the extreme north. *Bull. Appl. Bot. Leningrad*, Ser. A (17), 1936.

86. Ščerbina, D. R. Crossing ecologically and geographically different races of wheat. *Bull. Appl. Bot. Leningrad*, Ser. A. (18), 1936.

87. Beaven, E. S. Barley for brewing since 1886. *Jour. Inst. Brew.*, **42**, 1936.

88. Beaven, E. S. The culture of barley for brewing. *Jour. Inst. Brew.*, **40**, 1934.

89. Bishop, L. R. Barley varieties for brewing. *Jour. Inst. Brew.*, **41**, 1935.

90. Hopkins, R. H. Recent developments in Institute's research work. *Jour. Inst. Brew.*, **41**, 1935.

91. Bishop, L. R. Effect of variety, soil and season on the barleys and malts of the seasons 1932 and 1933. *Jour. Inst. Brew.*, **42**, 1936.

92. Bishop, L. R. New light on malting and brewing. *Jour. Inst. Brew.*, **42**, 1936.

93. Butler, E. S. Survey of the brewing industry, 1886–1936. *Jour. Inst. Brew.*, **42**, 1936.

94. Lancaster, H. M. Advances made during the last 50 years in malting. *Jour. Inst. Brew.*, **42**, 1936.

95. Snelling, Alan. Foreign barley. *Jour. Inst. Brew.*, **42**, 1936.

96. Thorpe, K. S. Foreign and colonial barleys, 1935. *Jour. Inst. Brew.*, **42**, 1936.

97. Amos, A. Changes made in hop growing in 50 years. *Jour. Inst. Brew.*, **42**, 1936.

98. Salmon, E. S. 19th report of the trial of new varieties of hops. *Jour. Inst. Brew.*, **42**, 1936.

99. Salmon, E. S. Two new varieties of hops: "Fillpocket" and "Quality Hop." *Jour. S.E. Agric. Coll., Wye, Kent*, **38**, 1936.

100. Biffen, R. H. Huskless oats. *Jour. Min. Agric.*, **43**, 1936.

101. Parker, W. H. Huskless oats. *Agric. Quart. Jour., Hereford C.C.*, **4**, 1936.

102. Jones, E. T. Observations on yield trials and varieties of spring sown oats in relation to different levels of fertility. *Ann. Appl. Biology*, **22**, 1935.

103. A new oat variety for hill land: Ceirch Llwyd Cwta (S. 171). *Univ. Coll. Wales, Aberystwyth.* Leaflet Series S. No. 3, 1936.

104. Cunliffe, Norman. Studies on *Oscinella frit* Linn. Inheritance of resistance of oats to attack by the fly, and the combination of resistance with other characters of agricultural importance. *Ann. Appl. Biology*, **23**, 1936.

105. Armstrong, S. F. Trials of sugar beet strains, 1933–35. *Jour. Nat. Inst. Agric. Bot.*, IV., 1937.

106. Thompson, E. G. Spring oat trials, 1932–1935. *Jour. Nat. Inst. Agric. Bot.*, IV., 1937.

107. Brandreth, B. County spring oat trials, 1935. *Jour. Nat. Inst. Agric. Bot.*, IV., 1937.

108. Bryan, H. The Lord Derby gold medal awards. *Jour. Nat. Inst. Agric. Bot.*, IV., 1937.

109. Bryan, H. Lord Derby gold medal trials, 1936. *Jour. Nat. Inst. Agric. Bot.*, IV., 1937.

110. Brandreth, B. Potato trials, 1936. *Jour. Nat. Inst. Agric. Bot.*, IV., 1937.

111. Bryan, H. The importance of healthy seed in potato culture. *Jour. Nat. Inst. Agric. Bot.*, IV., 1937.

112. Brandreth, B. Potato quality trials, 1935 and 1936. *Jour Nat. Inst. Agric. Bot.*, IV., 1937.

113. Brooks, F. T. Some aspects of plant pathology. *Agric. Live Stock in India*, **6**, 1936.

114. Stakman. E. C. The problem of specialization and variation in phytopathogenic fungi. *Rep. Sixth Bot. Congress*, Vol. 1, 1936. Publ. by E. J. Brill, Leiden.

115. Blackman, G. E., and Templeman, W. G. The eradication of weeds in cereal crops by sulphuric acid and other compounds. *Jour. Agric. Sci.*, **26**, 1936.

116. Phillips, C. Louise, and Boerner, E. G. Barley and barley malt. *U.S. Dept. Agric. Bur. Agric. Economics, Grain Division. Washington D.C.*, July, 1935. (Mimeographed.)

DISEASES OF ANIMALS: PREVENTION AND TREATMENT.

I.—Influence of Contagious Abortion and of Mastitis upon the Milk Yield of Cows.

It is often said, and is undoubtedly true, that the agricultural industry suffers great losses through animal disease. But when an attempt is made to amplify this statement by providing concrete information, one is often placed in some difficulty. It may be that the data required cannot be obtained at all; perhaps more often there is doubt as to the reliability of the data on which estimates are to be based or as to their applicability to general farming conditions. For these reasons, estimates concerning economic loss have to be scrutinized with care and often accepted with reserve. A case in point is the influence which the disease, contagious abortion, is alleged to exert upon the milk flow of affected cows. It is, of course, quite easily to be understood, on physiological grounds, that cows whose pregnancies are interrupted will give less than their normal yields of milk. But it is another matter to express this reduction in figures, firstly because, as is so well known, milk yield is a highly variable character, and secondly because diseases other than abortion may profoundly upset the calculations.

In 1936, F. C. Minett and W. J. Martin published an article containing information designed to give an idea of the influence on the milk yield of the two common diseases, contagious abortion and mastitis (Ref. 1). In this article it is pointed out why the problem is one of special difficulty. The amount of milk which cows give is governed by heredity and by what may be termed "environment," which comprises such factors as the state of health of the animal, nutrition, age, the length of the dry period, etc. Clearly, therefore, when an attempt is to be made to determine the effect of any one disease, such as mastitis, on the milk yield, it is necessary to observe animals of the same breed, living under the same conditions of management in a herd where diseases other than mastitis are not present; and in order that the milk yields of individual animals may be "standardized," *i.e.*, made directly comparable one with another, one must apply

to the milk-yield figures so-called correction factors. These factors, as H. G. Sanders (Ref. 2) observed, must be used in respect of age, length of the next previous dry period, service period (interval between calving and next effective service), and month of calving. Finally, it is necessary to work with sufficiently large groups of animals, in order that the figures obtained may be subjected to statistical analysis and their true meaning established.

Before giving their own results, Minett and Martin critically review the relevant literature, most of which is supposed to relate to abortion and surprisingly little to mastitis. Unfortunately, the value of much of this work is very doubtful. Not only does the loss of milk from abortion, as estimated by different authors, vary considerably, but it is not clear, in most cases, that correction factors were used, or that the effect of mastitis was excluded.

The observations of the present authors were made in two large self-contained herds of some 150 and 200 cows respectively, almost all of which were Friesians and Ayrshires. These herds, which are designated herds I and J, were free from tuberculosis and as far as possible from any diseases, other than mastitis and abortion, which might affect the yield. With herd I, where machine-milking was followed by hand-stripping, the yields for the milk-recording years 1929–31 were examined; with herd J the observations covered the milk-recording years 1930–34, and milking was by hand, except for a short time in one group of cows when a machine was used—an alteration which, however, for reasons stated in the article, could scarcely have affected the results.

At the beginning, both herds contained reactors to the blood-agglutination test for abortion as well as animals affected with mastitis, and serious efforts have been made to eliminate these diseases by isolation and eventual disposal of infected stock. As an indication of the extent of infection with abortion, it may be remarked that in herd I in 1931, out of 195 cows tested, 57 gave definitely positive reactions to the blood test, while in herd J in the same year 61 reactors were identified. As regards mastitis, in herd I in 1929, of 158 cows examined 87 were found to be infected in at least one quarter of the udder with the streptococcus of chronic mastitis, and in herd J, between November, 1931, and June, 1932, 83 cows out of 203 were found to be affected. In both herds, too, mastitis due to other bacteria made its appearance from time to time. Control efforts directed against both diseases have met with a considerable measure of success; with this object, that portion of the stock presumed to be healthy was periodically examined for abortion by the blood test and for mastitis by bacteriological tests of the milk.

As a result of this system of testing, the cows in herds I and J were sorted into four categories—

(1) cows free from both diseases;
(2) cows free from abortion but affected with mastitis;
(3) cows free from mastitis but affected with abortion;
(4) cows affected with both diseases.

For the sake of brevity, the four categories are referred to as the M− A−, M+ A−, M− A+, and M+ A+ groups. The classification of animals as regards mastitis was not always so simple as might be supposed, because the diagnosis of this condition is not always a straightforward matter; but wherever there was any doubt the animal was excluded. It should also be mentioned that the sorting into four groups was done by one of the authors who at the time had no knowledge of the milk yields. In the original article the average yields of animals in the different categories and at different lactations are given in detail, together with a full statistical analysis. One difficulty was to obtain a means of expressing adequately the difference between the yield of healthy and of diseased animals. The only means of standardization available was that of Sanders, but as Sanders in his work could not take the disease factor into account, his method was not very suitable for the present purpose. Nevertheless, even by the method advocated by Sanders, a statistically real distinction could often be made between the average yields of cows in the different categories. With regard to breed, the results cover the records of 180 lactations in Ayrshires, 193 in Friesians, and 21 in Guernseys and Shorthorns. The figures for all lactations may be set out as follows:—

	M− A− (1)	M+ A− (2)	M− A+ (3)	M+ A+ (4)
Total lactations	154	128	42	70
Average yield (uncorrected) in lb.	7,627	7,533	7,201	7,354
Average yield (corrected) in lb.	8,803	7,849	8,137	7,118
Difference between healthy and (2), (3) and (4)	—	954	666	1,685

These figures show that the average reduction in milk yield per lactation was 954 lb. due to mastitis and 1,685 lb. due to mastitis and abortion combined. The results were further dissected to find out whether there were any differences due to breed and age (as judged by the number of lactations), and in all cases the statistical significance of the figures was tested by Sanders' formulæ. The following differences are in all cases statistically significant. Among the Ayrshires of herd J the average reduction due to mastitis was 892 lb. Among the Friesians of herd I, the average

reduction was 1,602 lb. due to mastitis, 2,016 lb. due to abortion, and 2,302 lb. due to both diseases combined.

Another and perhaps more striking method of expressing the results is in terms of percentage fall in yield by comparison with that for healthy cows. When worked out in this way, the figures show that among the Ayrshires mastitis reduced the corrected yield on an average by 10·8 per cent.; among the Friesians the percentage loss was higher, averaging 16·5 and 19·5 respectively in the two herds. Among the Friesians of herd I the percentage reduction in corrected yield due to abortion infection averaged 20·7, *in spite of the fact that these animals did not abort.*

Before concluding this section, there are a few points which require emphasis. It has been seen that the average reduction in yield due to mastitis is heavy, and it might be thought therefore that the herds were exceptional in respect of the amount and kind of mastitis present. This, however, was not the case. In both herds the udder infection followed the usual insidious and slowly progressive type (Ref. 3), and there was nothing of the nature of an acute outbreak which would tend to make the reduction in yield unusually severe. Comparatively few cows had entirely lost a quarter, and it was ascertained that the extent of disease in the individual animals was not unduly great. A second point to be noted is that the reduction in yield was much more pronounced among the Friesians than among the Ayrshires. This was not due to the Friesians being older on the average than the Ayrshires, nor to actual abortions occurring among the Friesians. Apparently, the explanation is that in a high-yielding breed the milk-secreting tissue is destroyed in relatively higher measure when it is invaded by pathogenic bacteria than is the case with breeds giving a more moderate yield. A third point is that both mastitis and abortion infection may be associated with a significant fall in yield without there being any shortening in the lactation period. Hence the reduction, even in the case of cows which do not abort, must be due to a more or less continuous decrease in the amount of milk secreted.

In conclusion, if a loss of milk, found by Sanders' method to amount on a average to 89 gallons per lactation in the Ayrshire breed and to 160 gallons in Friesians, may be expected to accompany mastitis infection, the aggregate loss to the industry from this cause alone must be tremendous. And this, of course, is not the only factor to be considered. Allowance has to be made for the excessive herd wastage and for the depreciation in market value of infected animals, and, finally, there is the effect of disease upon milk quality. The results presented also go to show that the increased cost of milk production caused through mastitis is raised still further by infection with contagious abortion and—

a point of great interest and importance—that this may be so even though the cow does not actually abort.

II.—Survival of Tubercle Bacilli on Pasture.

In *The Farmer's Guide* for 1933 (Ref. 4), an account was given of some experiments on this problem which were carried out at the National Institute for Research in Dairying, Reading, by the late Dr. Stenhouse Williams and W. A. Hoy and, later, by E. C. G. Maddock. One of the main conclusions of the first-named workers was that in cowpads artificially contaminated with tubercle bacilli, and protected from rain and direct sunlight, the organisms could survive for about six months in the autumn and winter and for four months in the summer. When the contaminated dung was stored in pots in the ground, however, the organisms were proved to survive as long as two years. Maddock's work was in part on somewhat similar lines, but greater attention was paid to the question of freeing the contaminated material from bacteria other than the tubercle bacilli before it was inoculated into guinea-pigs to see whether living tubercle bacilli were still present. By means of this rather different technique, Maddock was able to show that even during the summer some tubercle bacilli can survive an exposure of six months, though this was the extreme limit. It was also shown that when a suspension of tubercle bacilli is sprayed on the growing grass (in the month of April), the organisms can be recovered from the grass up to forty-nine days.

Since 1933, further progress has been made and the results published (Refs. 5 and 6). In the first place, the opportunity was taken to repeat some of the previous work, with findings which were substantially similar. Thus, tubercle bacilli, contained in tubercular material from cattle and mixed with soil and dung, survived for 152 days in an experiment which was started at the beginning of June. When emulsions of tubercular tissue were sprayed on to growing grass in the months of June and July, the organisms could not be recovered three weeks later, but when this experiment was repeated in September, tubercle bacilli were found to be alive on one occasion after sixty-three days.

In all the experiments so far reported the test of survival was made by inoculating the material into guinea-pigs. This is a very delicate test for the presence of living tubercle bacilli, but is, of course, not a very practical one. If it could be shown that the surviving tubercle bacilli were capable of infecting animals which were put to graze on the contaminated pasture, the results would be of far greater interest and practical importance. In his more recent work Maddock has put this possibility to the test.

A first series of experiments was made on guinea-pigs. An

area of pasture was heavily contaminated with tubercle bacilli in the month of May by spraying on to it a fine emulsion of tubercular bovine lung. The guinea-pigs, usually in batches of twelve, were confined in wire runs and allowed to feed on the grass at various intervals after the spraying. Every day for twenty-one days each batch of guinea-pigs was moved to a fresh piece of the pasture, after which they were kept on clear ground long enough for any infection in them to develop. In this experiment 125 guinea-pigs were used, and they were placed on the grass at various intervals from one to 106 days after it had been contaminated. None of the guinea-pigs, however, contracted tuberculosis. In a second trial some pasture was heavily contaminated with tubercular emulsion not once but on four occasions, namely, in June, July, August and September, and the procedure was varied in that, while one group of guinea-pigs was allowed to graze much as before, another group was kept in a shed and fed on the cut infected grass at the rate of 2 oz. per head daily. This time eight out of ten animals in the first group, and six out of twelve animals in the second group, became infected.

Coincidently with this second trial, six calves from tuberculin-tested herds, which had also passed the tuberculin test, were exposed to the contaminated pasture, one group of these animals being allowed to graze on it for about five months, beginning the day after the grass was sprayed, while the second group of three was kept in a house and fed with the cut infected grass. A third group of three calves, also from tuberculin-tested herds, were kept in the Institute herd as controls. The result of this trial was that the three calves which grazed the pasture and two of the three fed on cut grass contracted tuberculosis, while the three controls and one calf of the second group remained healthy.

Having established in this way the possibility that susceptible animals might become infected by feeding on highly contaminated pasture, it was obviously necessary to make tests under conditions more closely simulating those of nature. It was therefore arranged that an area of pasture, about two-elevenths of an acre in extent, should be contaminated (*a*) with the dung of tuberculous calves which at the same time were being fed with emulsions of tubercle bacilli, (*b*) by tubercular cows which were passing tubercle bacilli in their dung.

In the first of these experiments, three of the calves were used which had become infected in the previous experiments, but in order to ensure that their dung should contain plenty of tubercle bacilli, the calves were fed on milk whey, to which were added tissue suspensions rich in tubercle bacilli. This feeding was continued during the three weeks (April 17th to May 8th) when the calves were allowed to graze in the experimental enclosure,

and at the end of this time the calves were removed and the infected dung spread over the grass as evenly as possible. About one month later, by which time a good crop of grass had grown, the enclosure was divided into three plots, and two calves which had passed the tuberculin test were put to graze on the first plot. One month later, two similar calves were grazed on the second plot, and after a further month a third pair of healthy calves were placed on the third plot. In each case, after the calves had grazed for three weeks, they were removed to a clean paddock, where—with two exceptions which died in the interim of inflammation of the bowels—they remained until they were slaughtered seven, six and five months after removal from plots 1, 2 and 3, respectively. During this isolation period, those surviving the full time passed three tests with tuberculin and in all cases careful examination of the organs after death failed to show any tuberculosis. It should be remarked that the weather during this experiment was hot and dry and that attempts to show the presence of active infection in the soil, dung and grass were successful only in the case of the first plot just before the test calves were put to graze on it.

In the next experiment, a cow suffering from advanced tuberculosis of the lungs, tuberculosis of the udder, and known to be excreting tubercle bacilli in the dung was allowed to graze on the experimental pasture for nine-and-a-half weeks (from January 25th). During the last three weeks a second tubercular cow was turned on to the pasture, though it was subsequently found that this cow was not so badly affected as was hoped and as her appearance suggested. After the cows were removed, the dung was well distributed over the enclosure as before, and six months later, when the grass had grown again, the area was divided into two plots. Three healthy Shorthorn calves about fourteen weeks old were then put to graze on plot 1, and about a month later three healthy Friesian calves of about the same age were grazed on plot 2. The latter consumed the grass much more quickly than the Shorthorns, so that after they had grazed for fifty-three and twenty-four days, respectively, the two plots were exhausted of grass. The calves were then removed to clean pasture and when slaughtered, rather over one year later, they were found to be free from tuberculosis. Finally, when the grass in the enclosure had grown—eleven weeks after the experimental calves were removed—the dividing fence was taken down and three more Friesian calves were allowed to graze the whole area for nine months. They were then slaughtered and found to be free from tuberculosis.

Even a cursory perusal of this account will indicate that infected pastures are unlikely to be a dangerous source of infection to clean cattle, and this impression is confirmed when the results

are examined more closely. The conditions of the last two experiments can be reasonably regarded as simulating those found naturally, but differing in that in both cases contamination of the pasture was heavier—and in the first case very much heavier—than would occur under ordinary circumstances. In spite of this, healthy calves, put to graze the pasture four and six weeks after the diseased cattle had been removed, failed to develop any sign of infection.

It may now be useful to enquire whether these more recent experiments should modify in any way the concluding statements written on this subject in *The Farmer's Guide* for 1933 (Ref. 4), which were as follows: "What the chances are of healthy cattle becoming infected by grazing on contaminated land is for the moment a matter of conjecture and one that requires investigation. Pending further information on this point and taking the chances into consideration, there is at present justification for recommending that pastures which have been inhabited by tuberculous cattle should be allowed to remain vacant for at least a full autumn and winter or for the spring and summer months. If it is possible to leave them vacant for longer than this, say for ten to twelve months, the risk becomes still more remote." While it ought to be remembered that the evidence provided by these more recent experiments on pasture infection is of a negative nature, it can be suggested that the last two sentences of the quotation err on the cautious side. Whatever opinion is formed as to the risk involved, it is quite clear that the chances of clean animals becoming infected from pasture are very small compared with those arising from contact between diseased and healthy animals, particularly when they are confined in buildings.

III.—"Swayback" in Lambs.

A short account of the condition which goes by this name is included, not merely because of its intrinsic importance but also because it forms an excellent example of how modern research in agricultural matters is slowly but surely clearing up obscurities. Until recently, practically nothing was known regarding "swayback," but now for the first time the nature of the condition has been laid bare by the investigations, at the Institute of Animal Pathology, Cambridge, of J. R. M. Innes (Ref. 7). Actually, the importance of this work goes far beyond the bounds of veterinary science, because Innes has shown that "swayback" is the counterpart of a serious disease of the nervous system in man, which is known as "Schilder's disease." In the past, research on this and similar human ailments has been severely handicapped by the fact that they could be studied only in human beings who had succumbed to the disease in its later stages. The

discovery of a closely allied disease in animals—incidentally of a type not previously met with among domesticated animals—therefore encourages the hope that research on Schilder's disease may soon be undertaken with greater profit.

The names "swayback," "swingback," "swingleback" and "jinkback" are used by shepherds for a disease of young lambs probably on account of the most prominent symptom, viz., "inco-ordination" of movement, which appears as a swaying or swinging of the hind quarters. There is reason to believe that this disease has been known to farmers for very many years. It does not appear to be peculiar to this country, since a disease of lambs with the same symptoms has been reported from South America, South Africa, Australia and Sweden. In England and Wales "swayback" seems to be comparatively widespread, and is not, so far as can be judged, confined to particular localities. According to W. Lyle Stewart (Ref. 8), who reported on the disease in 1932, it also occurs in the South of Scotland. In some flocks from 10 to 50 per cent. of the animals may be affected, and exceptionally the incidence may reach 90 per cent. On some farms outbreaks have occurred in many successive seasons, while some say that the prevalence has been increasing since 1933. The disease is not confined to any particular breed nor associated with any particular family of ram or ewe. It is not yet known if a ewe which has given birth to an affected lamb invariably bears an affected lamb the following year; there is no relationship to sex of lamb or to the bearing of twins; but there is some support for the suggestion that the lambs of older ewes are more prone to be attacked. Some lambs are affected at birth, while others do not show symptoms until they are a few weeks old. In the experience of Innes, the latest age at which symptoms were noted was six weeks.

A constant symptom is inco-ordination of movement, which varies in severity from case to case. Some lambs are quite unable to stand or walk, while others can rise with difficulty and walk with a staggering gait. It should be noted that paralysis is never total; affected lambs which cannot rise attempt to do so from time to time, and there are strong muscular contractions when the feet are pinched. In many cases, too, there is blindness, but it is noteworthy that symptoms of fever are absent. Affected lambs are still capable of taking milk from a bottle, but even with artificial feeding symptoms gradually get worse and death is believed to occur invariably within a few weeks.

On post-mortem examination, no abnormalities of any consequence are to be found outside the nervous system. In order to understand the nature of the change which occurs in swayback it is necessary to refer very briefly to the normal structure of the brain and spinal cord. Both these parts of the

nervous system are composed of two kinds of tissue, known respectively as the grey matter and the white matter. The grey matter of the brain consists essentially of nerve cells, while the white matter is largely composed of nerve fibres which are derived from these cells. Each nerve cell, in fact, is attached to a fibre, by means of which it is linked up to a muscle or some structure at a distance from the brain. Many of these fibres are located, during a part of their course, in the white matter of the spinal cord, and at intervals some of them leave the cord and constitute the nerves which are visible at a post-mortem examination. These fibres are ensheathed or protected by a fatty substance known as *myelin*, and the whiteness of the nerves, and of the white matter of brain and cord, is due to this substance. Now swayback is essentially a "demyelinating" disease, that is to say, one in which for some reason the myelin sheath disintegrates or degenerates; as a result, secondary destructive changes take place in the nerve fibre proper, with the final consequence that nervous control of muscular movement is lost. In cases of swayback the degree of demyelination varies considerably, and the change can often be detected only when sections of the brain are treated in special ways and examined microscopically. In eleven of the thirty-two cases examined by Innes, however, demyelination was so extensive that changes in the brain were easily visible to the naked eye. When the skull was opened, there was seen to be an excess of the so-called cerebro-spinal fluid, the white matter was abnormally flabby and contained cavities filled with a clear fluid or with gelatinous material. No congestion of the blood vessels, or other sign of inflammation suggestive of an infective process, could be observed.

The important question then is as to the cause of this demyelinating process, and it must be admitted at once that this question cannot be answered in the present case any more satisfactorily than in the case of the far more studied demyelinating diseases of man. One or two points, however, seem to be quite clear. In the first place, the disorder can originate before the lamb is born. This was shown by the presence of severe degenerative changes in the brains of animals only three days old, and in fact the severity and extent of the lesions bore no relation to the age of the lamb. In the second place, there is nothing whatever to suggest that swayback is an infectious disease, that is to say, that it is due to living organisms such as bacteria or filterable viruses. Further, there is no evidence that the disease is hereditary or that it is due to deficiency of vitamins or of mineral substances. The suggestion has been made that the disease is caused by some poisonous substance which is carried by the pregnant ewe and which, while having no obvious effect on the mother, exerts a harmful action on the developing

lamb. At the moment, however, this is almost pure hypothesis, It is has been seriously suggested that perhaps the poisonous agent is lead, but the evidence for this is extremely slender

IV.—Foot-Rot in Sheep.

A number of factors contribute to the economic importance of foot-rot: there is the long period of inactivity of affected animals, the loss of body weight—resulting in part from the inability to get enough food—the decreased production of wool and milk, the cost of constant treatment, and lastly its power of spreading to other sheep. The disease is referred to here because in the United States and Australia since 1930 much research has been carried on as to the conditions in which it appears, its causation and treatment. The information obtained from these researches has now reached a point at which it may usefully be summarized.

At one time it was generally supposed that the disease was due to constant softening of the horn as a result of wet conditions, and this view is probably still widely held among farmers. Some experiments and observations which have been made are, however, definitely opposed to that view. Firstly, there is the observation that flocks sometimes remain free from foot-rot until a few infected animals are purchased, after which it spreads rapidly to many members of the flock. Then, from the experimental standpoint, it was shown in 1933 by D. Murnane (Ref. 9), working in Melbourne, that if clean sheep are kept standing in water for about eight hours each day for several weeks they do not get foot-rot. Hadleigh Marsh and E. A. Tunnicliff (Ref. 10), at the Montana Veterinary Research Station, also proved quite undeniably that long-continued exposure of sheep to muddy or swampy conditions will not induce foot-rot. Nor can the disease, as W. I. B. Beveridge, in Sydney, New South Wales, has shown (Ref. 11), be set up by any ordinary process of suppuration. In a number of cases the soft horn between the hooves was deeply scarified and cultures of ordinary pus-forming bacteria were applied, but although the pus which formed underran the horn, such infections cleared up spontaneously without causing foot-rot. On the other hand, when material from foot-rot cases was applied to feet prepared in the same way, the typical disease could often be set up, and this was particularly easy when the animals were kept under wet conditions.

Experiments of this sort, together with observation of the conditions under which the disease appears naturally, have led to the conclusion that foot-rot is an infectious disease of sheep, and therefore due to some living organism. The task of discovering this organism has not proved to be a straightforward matter, because material from naturally diseased feet, even after

these have been well washed, contains a number of different species of bacteria, and it becomes a question of deciding which is the primary invader. J. R. Mohler and H. J. Washburn, in the United States, as long ago as 1904 (Ref. 12), believed that foot-rot is caused by an organism called the "necrosis bacillus," and some other workers have reached a similar conclusion. This bacillus is well known as a common inhabitant of the alimentary tract of certain animals, and of soil, and is recognized as the cause of a number of disease conditions in animals, such as "calf diphtheria," "quittor" and "fistulous withers" in horses, and certain lesions in the liver of cattle. The lesions produced by the organism in these conditions are characterized by "necrosis," *i.e.*, death of the tissues involved. Foot-rot is essentially a disease in which there is necrosis of the soft or "sensitive" tissues of the feet and there seems to be no question but that the necrosis bacillus is responsible at least in part for these lesions. Thus enormous numbers of these organisms are commonly present in the affected tissues quite early in the disease, and particularly at the junction of the healthy and affected tissues. In spite of this, some workers attach primary importance not to the necrosis bacillus but to organisms known as "spirochaetes," the bodies of which have a peculiar spiral shape. Very recently, Beveridge (Ref. 13) has produced evidence that foot-rot is due to a rather special kind of spirochaete, which he calls *Spirochaete penortha*. At the moment it cannot be said that the cause of foot-rot has been definitely established, since it is doubtful if the typical progressive disease has ever been set up artificially by direct application to the feet of cultures of any of the organisms which have been found in foot-rot material. Thus Marsh and Tunnicliff failed to set up the disease even when cultures of the necrosis bacillus were injected into the feet of sheep which had been softened by standing for a month in a wet pen. They were also unable to produce the disease in sheep kept on wet soil which was repeatedly sprinkled with large quantities of culture of the necrosis bacillus. Whatever organism is in the main responsible, however, it seems certain that wet conditions act as a predisposing cause by injuring the skin and horn and so permitting the entry of a special parasite.

With regard to the changes in the feet, the disease starts, as sheep farmers well know, with lameness in one or more feet. Owing to the pain, badly affected animals walk on three legs or move about on their knees if the fore feet alone are involved. The lack of wear leads to distortion of the hoof, and the horn of the sole becomes underrun with pus, causing its separation from the sensitive tissues beneath. Cases tend to be of long standing; the whole hoof may be shed, exposing an unhealthy-looking, bleeding surface, which gives off a characteristic offensive

odour. There is also ulceration of the skin between the hooves. Occasionally the disease progresses more slowly, or for months may appear to be at a standstill.

Marsh and Tunnicliff (Ref. 10) carried out a good deal of work on the experimental transmission of foot-rot at pasture and on the persistence of infectivity of such pasture. To illustrate the advance in knowledge which has been made, some of these experiments are briefly described. The first object was to produce an infective pasture; for this purpose about an acre of grassland was fenced off and kept constantly wet by water flowing from an irrigation ditch. Between July 31st and October 13th 20 sheep showing active lesions of foot-rot were placed on this pasture, and of these 14 were removed on September 25th. In order to test the possibilities of transmission, healthy sheep were put on the pasture in three batches, viz., four (three ewes and one lamb) on August 2nd, four (two ewes and two lambs) on October 1st, and 20 on October 24th. The 28 sheep comprised in these batches developed foot-rot after exposure for 21 days, 22 to 26 days, and 10 to 14 days respectively, and all but three became progressive cases. The possibilities of transmission at pasture were also clearly demonstrated by Marsh and Tunnicliff, by holding sheep in three small pens, each 12 feet square, the soil of which was kept constantly wet. Two of the pens were infected by holding in them sheep affected with foot-rot. The third pen was used as a control, no infection being introduced. Two healthy sheep were kept in the control pen for 34 and 63 days respectively, but they developed no foot-rot though constantly standing in mud. On the other hand, of eight sheep exposed in the other pens, all (two ewes and six lambs) developed foot-rot, within 17 days in the case of the ewes and 50 days in that of the lambs. In this connection it may be noted that in outbreaks of foot-rot lambs are much less susceptible than ewes.

These experiments of Marsh and Tunnicliff are similar to those reported in 1933 by Murnane, who found that the disease could be set up in clean sheep by keeping them for four months in small pens in contact with natural cases. Healthy controls kept under similar conditions, but not exposed to diseased sheep, remained unaffected.

Having thus established the ease with which the disease can be contracted by healthy sheep on infected pasture, Marsh and Tunnicliff instituted experiments to test the duration of infectivity of such pastures. The first two experiments were designed to see how long very small areas of pasture, viz., pens 12 feet square, would remain infected under wet and under dry conditions. Pen No. 1 was used to test the persistence of infection in the soil when it was kept saturated with water. As soon as it had been definitely established that the pen was infective to

healthy sheep, all sheep were removed and the pen was left vacant for 30 days. Three healthy sheep were then introduced and kept there for 54 days, but none of them developed foot-rot. Pen No. 2 was used in a similar manner, except that after the removal of the infected sheep the soil was no longer watered but was allowed to dry off. After 15 days it was again saturated with water and three healthy sheep were introduced and kept in the pen for 48 days. No foot-rot developed, indicating that 15 days' drying had sufficed to destroy infection. A third experiment was concerned with the duration of infectivity of the 1-acre pasture used for testing natural transmission of the disease. It will be noted by reference to the above account of these tests that 20 healthy sheep placed on this pasture on October 24th had developed foot-rot within 14 days. On November 19th all sheep were removed from the pasture, and from November 13th to March 20th the ground was covered with several inches of snow. From April 6th to May 20th 10 healthy ewes were placed on the pasture, but none of these developed foot-rot.

A fourth experiment was concerned with the infectivity of a swamp pasture. In the summer of 1930 foot-rot appeared in a flock of 1,200 ewes and within six weeks had spread to about 90 per cent. of them. Early in August, 1930, the sheep were removed and the area was left vacant till May 22nd, 1931, when 41 healthy sheep were fenced on about 15 acres of the swamp. No sign of foot-rot was seen among these sheep until August 6th, when two were found to be lame. On August 12th the feet of all the sheep were examined and one sheep was found to be affected. Between that date and October 22nd, when the sheep were removed from the swamp, 11 had shown definite signs of foot-rot. This experiment appears to show at first sight that the swamp had remained infective from August to the following May, but there were several facts which rendered this conclusion doubtful. Thus, lameness did not appear among the exposed sheep for two-and-a-half months after they were put out to graze, and at the end of five months only one-third of them were affected. Further, the lesions in all cases were slight and did not progress in the typical manner. It seems more probable that the result is to be explained in another way, namely, that the infection was retained not by the swamp but by some of the exposed sheep, and that the disease in these sheep was rendered evident by exposure to the swamp. Some evidence in support of this view has been provided by Beveridge (Ref. 11). Beveridge observed that chronic lesions of the hooves might persist for over 18 months in experimental animals kept most of their time on concrete. Material from these chronic lesions was capable of producing foot-rot in sheep, so that it seems likely that infection may survive in the superficial lesions of a few sheep and spread to others when conditions become favourable.

In the matter of *prevention*, good land drainage is of course one of the first things to be desired, while the observation of Beveridge just mentioned suggests that the removal of chronic cases during the summer may greatly assist elimination of the disease. Preventive measures should be adopted in all flocks where foot-rot is known to occur, since prevention is much less costly and less troublesome than treatment. Such flocks should be carefully watched, and if any lame sheep are seen, all the animals should be collected and their feet examined. All overgrown feet should be trimmed, and visibly affected animals kept apart and treated at once. As a precaution, the remainder should be passed through a foot-bath, as described below. It is much better to put remedial measures in hand at this stage rather than to wait until the disease has spread to many other animals. If possible, the flock should be removed to drier pasturage, though it may be remarked that Murnane was unable to prevent the progressive development of the lesions in several very early natural cases which were removed from the country to a perfectly dry pen at the laboratory.

Treatment of foot-rot is a matter of common practice and, when properly carried out, good results are to be expected. One of the first essentials is the *very thorough* paring away of overgrown horn and of horn in process of becoming detached. After this, the more deeply-situated dead material and discharge must be completely removed. This, of course, is a painful operation and may be accompanied by much hæmorrhage, which can be controlled to some extent by tight bandaging just above the hoof. It is always wise to examine the feet of all the sheep in the flock, so that slight or early infections may be treated. After this careful trimming of the feet, the next step is to apply some solution with caustic properties in order to sterilize the infected tissues. For this purpose, solutions which have been recommended are copper sulphate (5 or 10 per cent., *i.e.*, ½–1 lb. to a gallon of water), and formalin (2 per cent.). These solutions should be used in foot-baths and it may be remarked that it is insufficient to allow the sheep to walk through the bath; they should be made to stand in it for at least an hour in order to give the solution time to penetrate into the numerous small crevices which remain in the foot even after careful trimming. Prior to this, it is a good plan to pass the sheep through a foot-bath containing water only, to cleanse the feet as much as possible. The foot-bath treatment should be repeated several times at two-day intervals, and the same solution can be used four or five times. Where possible, sheep should afterwards be held in a shed or on a dry floor for several hours. According to Murnane, formalin is better than copper sulphate, because, while being equally effective, it is cheaper (when 2 per cent. formalin is compared with 5 per cent.

copper sulphate), has a desirable hardening effect on the horn and does not stain wool.

Where many sheep are affected, the foot-bath, of course, has obvious advantages; where few sheep only are affected, local dressings are often used, though probably they are less efficacious and certainly more troublesome than the bath. One mixture recommended is warm Stockholm tar (one quart), into which is stirred 2 oz. of finely ground copper sulphate (bluestone) and a tablespoonful of lysol, the mixture being applied with a brush after stripping away the horn and dead tissue.

V.—Extermination of Wild Rabbits.

Measures which ought to be taken for the better protection of farm crops and trees from the ravages of rabbits have lately been the subject of enquiry by a Select Committee of the House of Lords (Ref. 14), and the matter will certainly be of interest to the many farmers who have had experience of the damage caused by these rodents. With some other destructive rodents, viz., rats and mice, attempts at extermination have been made by what may be called bacteriological warfare, that is to say, by inducing among them a fatal disease which would spread in epidemic manner. On the whole, such attempts have not been very successful, and this is not surprising to those who are aware of the results of a vast amount of experimentation which has been carried out on the subject in the laboratory. The main difficulty is that, while the great majority of rodents exposed to the force of an epidemic die, a few acquire the disease in a non-fatal form and in consequence become highly resistant. The final result is that the original population is replaced by one which may be as numerous as before and which is composed of resistant individuals.

Among the different measures which have been proposed during recent years for dealing with rabbits is that of extermination by bacteriological means, using for the purpose the filterable virus which causes the disease known as *myxomatosis*. An account of experiments on this problem, covering a period of more than two years, has recently been published by Sir Charles J. Martin (Ref. 15), working at the Institute of Animal Pathology, Cambridge. At the beginning of his article, there are laid down certain requirements for successful extermination by the means employed. The main points are that the disease must spread throughout the population and cause a very high mortality, leaving few survivors, the progeny from which must have little or no inherited resistance. The infection must remain highly active and not tend to "peter out" in the course of time. Finally, the disease must be harmless to domesticated animals.

Myxomatosis was first described from South America in

1898, and after its spread in that country it was met with in California among rabbits kept for fur production. It has never been recorded as occurring naturally in Europe. The disease has been given its name owing to the occurrence, in rabbits which survive for a week or so after symptoms are noted, of gelatinous swellings beneath the skin in various parts of the body, these swellings resembling the tumours which, on account of their microscopical structure, are known among pathologists as "myxomas." The disease can be transmitted quite easily from one rabbit to another by applying a little of the juice from a swelling to the scarified skin, by injecting it into the animals, or by placing a little of it between the eyelids. Rabbits so inoculated may die after a few days without showing any myxomatous swellings, if they are particularly susceptible and the virus especially active. Otherwise, the animals may be expected to sicken five or six days after inoculation and to die a few days later. The swellings also involve the skin, so that the hairs fall out and some of the liquid exudes. As the secretions from the nose and eyes, and also the swellings, contain enormous quantities of virus, it is easy to understand that the disease is likely to spread readily among rabbits living together. The infectiousness of the disease by contact was specially studied by Martin, firstly when the animals were kept in cages, and, secondly, when they were kept as colonies in the open, under conditions as natural as possible.

In the cage experiments, two samples of virus (A and B), sent from different laboratories, were passed through two separate series of rabbits. The procedure was to inoculate a rabbit and, as soon as it became sick, to place a healthy rabbit in the cage with it. In this way, the two viruses were passed in succession through 80 and 87 rabbits respectively, the experiment occupying 20 and 25 months. The B sample of virus was rather more active than the A sample, and with the former the rabbit usually died about 11 days after being put in contact with a sick companion.

In the experiments carried out under natural conditions, an area of pasture, 50 yards by 10 yards, was used. This was enclosed by a fence of ½-inch wire netting sunk 8 inches into the ground, and was surrounded by an outer fence 7 feet high and placed 2 yards from the inner and also sunk into the ground. The whole compound was roofed with netting. In the first experiment a portion, 10 by 7 yards, was fenced off to form an "annexe." Shelter for the rabbits was provided by means of boxes, open at the bottom, or by iron receptacles.

Four experiments in all were carried out during the period August, 1934, to November, 1935, the first two using tame rabbits and the A sample of virus, the last two using wild rabbits

and the rather more active B virus. In each case a certain number of healthy rabbits were placed in the compound, and after allowing two or three weeks for them to settle down, one or two rabbits were caught, infected by placing a little disease material between the eyelids, and then returned to the compound. In experiment 1, 23 rabbits, including an originally infected one, were put in the main compound and four in the annexe, while seven families were born during the experiment. The result was that the disease gradually spread until only two of the total population survived, though it was two months before it spread to the annexe. For experiment 2, 27 healthy rabbits were put into the enclosure, making, with three rabbits still surviving from the first experiment, a population of 30. Infection quickly spread from the survivors to two of the new entrants; then, as no more cases occurred during the next ten days, it was concluded that the infection was exhausted. A rabbit was therefore caught, infected in the eyelids and returned to the compound, with the result that the disease soon spread quickly and exterminated all the rabbits save one, including eight families born during the experiment. Had there been no epidemic, it is estimated that the population would have reached 70. In experiment 3, the total population at the beginning was 55, including the one survivor from experiment 2. Infection was started as before, two rabbits being inoculated, and the result was that the disease spread rapidly at first and then more slowly, so that the whole colony was exterminated in just over a month. Experiment 4 was a repetition of the last, 44 wild rabbits being used, and these were exterminated in just over a month. It is important to note in connection with the last two experiments that, as the rabbits used were wild ones, they spent most of their time in the burrows, so that there was good opportunity for contact. It was only when they became sick that they remained above ground; in fact almost all the rabbits died in the open.

These experiments then satisfy one of the requirements laid down above in proving that myxomatosis spreads rapidly by contact and is highly fatal. In the course of this work 560 rabbits contracted the disease by contact or by introduction of small amounts of infective material between the eyelids, and of these only 13 recovered. Some of these recovered animals were put to good use in two ways, firstly, to see whether the attack of myxomatosis had conferred upon them any resistance to the disease, and, secondly, to see whether their progeny would be susceptible or resistant. It was ascertained that the recovered animals had acquired a strong resistance which lasted for at least 12 months, but that their progeny were still quite susceptible.

A matter which is naturally of the first importance is the effect of the virus on other animals. Fortunately, there is every reason to believe that rabbits only can be infected and that even hares are insusceptible. So far as the domesticated animals of the farm are concerned, it can be said that attempts to infect horses, cattle, sheep, goats, dogs, cats and fowls have been fruitless.

The general conclusion from all these experiments therefore is most favourable. Everything points to the virus of myxomatosis satisfying the requirements laid down above, but the readiness with which the infection will spread to colonies in the neighbourhood depends not on the virus but on the amount of intercourse between the animals of the separated colonies.

VI.—Coccidiosis of Fowls.

This common disease is likely to remain for a long time to come one of the most troublesome that the poultry-keeper has to face.

The minute animal parasites which have been found in the intestine of a large variety of birds, both wild and domestic, suffering from coccidiosis, and which were first seen by Rivolta in Italy about 1870, were for years assumed to be one species. It is now known that the matter is much more complex than this, that even in the common fowl at least six quite distinct species of coccidia may inhabit the intestine, and that at least four of these are capable of producing disease. While natural infections with single species do occur, it is more common to find several species co-existing in the same bird. Something of the full significance of these findings will be understood when it is stated that recovery from an attack by one species leaves the chicken more or less resistant to that species but not to the others. In the past, the lack of knowledge on such points has led to much confusion, but by the modern methods now available the various species can be separated from one another, with the result that useful progress should now be possible.

In the present article—the purpose of which is to give a brief review of present knowledge, with special reference to control—it is not proposed to use the scientific names which have been allotted to the various species, partly because names are of somewhat academic interest, but mainly because it is not certian to what extent some of the species discovered are of importance in this country. It is definitely possible, however, to distinguish more than one form of the disease. In one of these, the two cæcal tubes of the fowl—that is, the blind segments of gut which open into the lower part of the intestine—are mainly involved, while in the other form some part of the small intestine is attacked, usually the duodenum or part nearest the gizzard. It will therefore be convenient to refer to the "cæcal" and "duodenal"

forms, but on the understanding that disease may not be entirely confined to these parts and that it may be caused by any one of at least three species of parasite. The cæcal and duodenal forms may also be referred to as acute and chronic respectively, but here again it must be understood that the duodenal form may sometimes be quite acute.

Life History of the Parasite.

Coccidia, as present in the droppings, are oval bodies of microscopical dimensions, which have a remarkable resemblance to birds' eggs. If atmospheric conditions are favourable, the contents of these minute bodies, which are known as *oöcysts*, undergo a ripening process (sporulation) leading to the formation of comma-shaped structures known as *sporozoites*. When ripe oöcysts are swallowed by a susceptible bird, the sporozoites are liberated in the duodenum and penetrate the cells of its lining, where a further series of changes takes place (the process of schizogony), leading to the formation of minute curved bodies known as *merozoites*. These are motile, and each one invades, and grows within, a cell of the intestinal lining. As several successive crops of merozoites can be produced during a single attack of coccidiosis, the intestinal tract may become heavily infected, with destruction of the lining cells. The method of multiplication so far is asexual, and when this comes to an end, it is succeeded by a sexual phase in which the merozoites develop into either male or female elements. The female elements constitute the oöcysts, and when these are fertilized by the male the oöcyst is ready to recommence the asexual cycle. To give some idea of the infective potentialities of coccidia, it may be said that, according to Tyzzer (Ref. 16), one sporozoite can give rise to 225,000 merozoites as a first crop, and, as eight sporozoites are produced within each oöcyst, a single developing oöcyst can give rise to over one-and-a-half million merozoites. The period during which the chick remains infected depends largely on the number of generations of merozoites produced, and the time each generation takes to develop.

Symptoms of Coccidiosis.

The cæcal form appears in chicks about 2–10 weeks of age. The symptoms vary with the intensity of the infection and are due in the main to hæmorrhage (bleeding) into the cæcal pouches. When this is severe, the chicks may simply be found dead, and on post-mortem the cæca and lower intestine are seen to be filled with blood. When the bleeding is less profuse, the chicks remain dull and listless, their feathers are ruffled, they crowd together for warmth, and become very pale and weak. Their droppings are blood-stained. Chicks so affected are often

found dead two or three days later, and post-mortem examination shows in the cæca altered blood, and at later stages cheesy masses, which on removal leave raw surfaces on the mucous lining. It should be pointed out that coccidiosis may predispose birds to other infections and that, when bacillary white diarrhœa is present in addition, the general severity of the disease is increased.

The duodenal form occurs chiefly in birds 10–12 weeks old, though cases also occur in birds as old as 12 or even 18 months. It is seen especially commonly in chicks a month or so after they have been taken from the brooders and placed outside on the ground. The death rate with this form is not so high at first, though ultimately it may be higher than in the acute form, and few affected birds recover sufficiently to be of economic value; most of them eventually die or are destroyed by the owner. The disease tends to be very persistent in a flock and the symptoms consist of loss of condition, lassitude, pallor, and shrivelling of comb and wattles. The appetite at first may be good, but later is indifferent. Blood is rarely found in droppings. Some birds show leg weakness and inco-ordination of movement. The changes seen in the intestine vary with the duration of the illness. In the early stages the wall of the duodenum, and parts of the midgut also, are thickened and its lining shows a greyish mottling or may be ulcerated. In connection with diagnosis, it should be noted that it is scarcely sufficient to demonstrate coccidia in the gut, because birds can tolerate very heavy infestations without showing symptoms. Other factors must be taken into consideration, such as the bird's condition; if this is not done, the real cause of death may be overlooked.

Experimental and Natural Infection—Means of Spread.

Experimentally it is quite a simple matter to set up coccidiosis by feeding the organisms to susceptible chicks. Working with one of the species which most commonly attacks older birds, Tyzzer, Theiler, and Jones (Ref. 17) found that infection was more severe in the older chicks (30- and 50-day) than in very young ones (six-day), no doubt because the intestinal canal is more fully developed and so gives greater scope for the multiplication of the parasite. With the parasite of the cæcal form no difference was found according to age. As stated above, infection may be brought about by a single oöcyst, though this fact is not surprising when the prolificacy of oöcysts is remembered. As an example of the results of feeding healthy chicks with oöcysts, the following instance may be noted. Tyzzer (Ref. 16) fed 84 chicks with the coccidium of the cæcal disease; deaths started to appear on the fifth day, when 14 died; on the

sixth day 48 died, and only 14 subsequently recovered—a mortality of 83 per cent.

Natural infection may be expected to differ from that following experimental feeding of healthy chicks with a single species of coccidium, since in nature oöcysts will be swallowed at irregular intervals and in varying numbers, and more than one species will probably be ingested. The natural disease may also be modified to some extent according to the conditions under which the chicks are reared, and by other still unknown factors.

The dissemination of infective oöcysts may occur in various ways. They may be spread by water supplies, be carried about by birds on their feet, by attendants on their boots, on sacks and other objects, or by mice, flies, etc. Oöcysts may be swallowed by birds of other species or by animals and so distributed. Coccidia are known to spread with some ease even under good conditions for prevention, and one of the difficulties facing experimentalists is to prevent infection in control chicks. Thus, Tyzzer (Ref. 16) found it practically impossible to prevent accidental infection in cages of chickens kept in the same room with cages of infected chickens.

Control.

Much effort has been made to control the disease by *therapeutic* methods, but it can be stated on good authority (Tyzzer [Ref. 16], Bayon [Ref. 18]) that up to the present none of the chemicals advocated serves either to prevent coccidial infection or to eradicate the disease after it is established. This should not be held to imply that the situation in this respect is hopeless, but rather that the matter is one requiring intensive study, especially on chemical lines.

What may be called *dietary* methods of control have also been recommended. There can be little question that a nutritious diet, *e.g.*, one containing egg or small amounts of milk, will help to tide chickens over the critical stages of the disease; but, apart from this, certain special diets have been put forward both for prevention and treatment. One of these is a mash containing 40 per cent. powdered butter-milk, given from the age of four to eight weeks. This so-called "milk-flush" treatment was investigated by Mayhew (Ref. 19) but, in a series of carefully performed experiments, he was unable to confirm its value. In these experiments 349 birds from the same batch were divided into two approximately equal-sized groups and dosed when just over six weeks old with similar numbers of coccidia. The special mash feeding was started in one group when the chickens were about eight weeks old, and the survivors were kept until they were about 20 weeks old. The weights of surviving birds in the treated group, taken at the twentieth week, were significantly

lower than those of control chickens from the same batch which had been dosed with coccidia and fed on the mash without butter-milk. Butter-milk mash has a distinct laxative effect, and Mayhew suggests that for this reason the treatment is contra-indicated, since moist conditions favour the ripening of oöcysts and so would favour the continuance of the epidemic. The feeding of rations containing a high proportion of milk-sugar (1 lb. to 1 cwt. mash) or of milk has likewise been advocated; the acid fermentation thus set up in the intestine was supposed to be injurious to coccidia. Experiments by Tyzzer (Ref. 16) with diets supplemented with milk-sugar or skim milk failed to substantiate this on experimentally dosed chickens; in fact, the only effect of the treatment appeared to be to cause the feathers to fall out. Kerr and Common (Ref. 20) indeed showed that the so-called "acid treatments"—*i.e.*, the feeding of milk, butter-milk, lactic acid cultures, or hydrochloric acid—do not in reality make the intestinal contents more acid, and these authors, too, doubt the value of such treatments.

Everyone is agreed that with present knowledge *hygienic* measures of control are the most helpful, and in this connection there are a number of important points to be considered. In the first place, it will be remembered that the parasite goes through a definite life-cycle, but even under favourable conditions of aeration, moisture and temperature, the oöcysts do not become infective until some 24 to 48 hours after they have been voided. If, therefore, the houses are thoroughly scrubbed out daily with hot water, soda and soap, or if the birds are moved daily to fresh ground, there is no opportunity for reinfection to take place. The second point is that, owing to their strong envelope, oöcysts—and particularly those which have undergone sporulation—have a considerable resistance to natural destructive agencies, especially under moist conditions. Thus, oöcysts can remain alive for more than a year if kept in a humid, non-putrefying medium at temperatures between freezing point and that of the body (100°F.). In the same connection, oöcysts are resistant to the action of the common disinfectants such as potassium permanganate, carbolic acid, soda lye, formalin, etc.; indeed it is well known that oöcysts will sporulate in some disinfectants (Pérard [Ref. 21]). Putrefaction, such as may occur in stored manure, prevents ripening of the oöcyst, which eventually dies, while oöcysts are also sensitive to temperatures above about 105°F., so that boiling water is useful for sterilizing drinking vessels and food troughs. The parasites do not live long at freezing temperatures or when desiccated, hence drainage of contaminated land, and the removal of thick grass which is likely to preserve the moisture of the soil, would be useful aids in prevention.

Other points having a bearing on the question of control are as follows (Ref. 22): (1) Adult fowls may harbour coccidia in their intestines; (2) coccidia of mammals and of other birds are incapable of infecting fowls; (3) infection does not pass through the egg; (4) the infection may be introduced by purchased stock; (5) with two species of coccidia it has been found that, after experimental infection, birds that appear comparatively normal may discharge very much larger numbers of oöcysts than ones which are actually ill; (6) the disease is a self-limiting one; (7) proper poultry management is of prime importance. With regard to the first two points, it is obviously wise to keep adult stock separate from chicks and, if possible, to have separate attendants. The disease can be retained in breeding places by adults, healthy in appearance, which harbour the parasites in their digestive tract. Oöcysts which have passed through the alimentary canal of insusceptible hosts are still fully infective to fowls. With regard to the third point, Tyzzer (Ref. 16) reports that in 14 different lots of day-old chicks purchased from various sources, and making a total of about 1,000, none proved to be infected with coccidia. Oöcysts may, of course, be deposited on the shell during laying, but actually the risk from these is not great, as the drying during incubation suffices to destroy them (Tyzzer and others [Ref. 16]). Lamont (Ref. 23) mentions that, in collaboration with Kerr, he spread infective droppings on eggs which were then incubated for three weeks. The egg shells were then powdered and fed to 24 chickens with completely negative results. Purchased stock should be quarantined for three weeks, especially if the birds are young, and carefully observed for signs of illness. The disease is self-limiting in that once the parasites have completed their life-cycle in the intestine, they pass out, so that if the chicks survive they are able to make a more or less complete recovery. This only occurs, however, if reinfection from the droppings is avoided. Advantage is taken of this fact in practice by keeping the chicks on wire-meshed floors, by which they are protected from reinfection by their own excreta. The value of portable "folding units" rests on the same principle, the units being moved to fresh ground every one or two days, that is, before the oöcysts have had time to reach the infective stage. The control of coccidiosis is likely to be more difficult in large-scale undertakings than in smaller flocks, but overcrowding must be avoided at all times, and all changes to which chicks have to be subjected should be gradual. At times outbreaks have occurred in brooders in spite of the floors being of wire-mesh; the source of infection in such cases may be found to be food or drinking vessels contaminated by birds which have picked up a slight infection from their food.

In practice, when acute coccidiosis breaks out among a small lot of chicks, it is much better to kill off and cremate the lot and start afresh after a thorough cleaning. If the outbreak is in a very large lot of chicks, they should be kept confined, dead birds should be removed as often as possible, litter and droppings burnt or buried deeply in farmyard manure, and the floor cleaned each day for at least a fortnight, or until the outbreak is over. In an outbreak of chronic coccidiosis, the badly affected birds should be killed off, the rest moved to fresh ground, and any showing symptoms immediately removed and killed. Those which remain alive should be given plenty of space and be well fed on easily digested mashes until they are fit for disposal. The usual rules of thorough cleaning must be observed, and the ground on which sick birds have been kept should, if possible, be rested for at least a year; lime should be applied at the rate of 6 cwt. to the acre, or the land may be dug up or ploughed.

Much attention has been given to the possibility of controlling coccidiosis by rendering the birds *immune*—that is, resistant to infection (Tyzzer [Ref. 16]). The fundamental observation in this connection is that after a chicken has successfully passed through an attack of coccidiosis it is proof against a second infection. As soon as it was possible to work with clean chicks and with pure strains of coccidia, the matter could be subjected to proper experimental enquiry. The two factors of importance are (*a*) the species of coccidium used and (*b*) the dose given. In a general way, it may be said that with pathogenic species large doses produce more severe effects than smaller ones. Small doses may be expected to produce an infection which does not make the bird obviously ill, and with some species this is followed by an immunity which is complete in the sense that the bird cannot be reinfected with large doses, or which is sufficient to prevent obvious illness on reinfection. Small repeated doses may have the same effect as one large dose, that is, may produce a severe and possibly fatal infection; or, with some species, small repeated doses may be followed by immunity—an immunity which may depend on the continued development of small numbers of parasites. It any case, as stated in the introduction, the immunity produced is strictly specific, that is, it is active only against coccidia of the same species. Immunity is usually strongest and most prompt in its appearance with coccidia which penetrate deeply and tend to be retained in the tissues. It is, of course, rather unfortunate that the immunity is so specific, because it means that non-pathogenic species cannot be used to protect birds against pathogenic species. It is also unfortunate that attempts to produce immunity against coccidia by giving the parasite by routes other than the mouth have failed. Thus, no infection or immunity is to be expected by injecting

ripe oöcysts into the rectum. When the cæcal type of coccidium is thus injected, the results are irregular, at most suggesting that only a few of the oöcysts reach the cæcum and hatch therein. Tyzzer (Ref. 16) on several occasions injected normal chicks rectally with bloodstained cæcal exudate containing great numbers of active merozoites and, though some of them undoubtedly reached the cæca, they failed to develop. Again, when merozoites are injected into the wing vein, there is neither infection nor immunity. Blood serum from immune birds is also useless as a protective.

The experimental observations of Tyzzer and of other workers afford an explanation of what has often been noted in practice. In favourable surroundings, *e.g.*, when chicks are reared under natural conditions on comparatively clean land, or kept on wire floors, they often have a chance of ingesting only a few oöcysts at a time, so that, without at any time showing symptoms or gross evidence of disease, they may gradually build up a resistance which is effective even against the most pathogenic species. This also explains why severe coccidiosis so frequently develops when chickens which have been reared in clean brooders are put out on the ground. How long the immunity of a chicken which has completely recovered from coccidiosis will persist is not known, but probably under ordinary conditions its resistance is reinforced from time to time by slight infections. It has been suggested that the disease should be allowed to run its course, with the idea that survivors will be resistant, but this is bad in practice, partly because many of the survivors will be carriers, and partly because resistance will have been acquired only against the particular species of coccidium which caused the infection. Another suggestion which cannot be recommended in practice is that chicks should be fed intensively with small doses of oöcysts. One objection to this is that some of the oöcysts fed pass through the intestine without hatching and may thus become a menace to other birds.

In conclusion, it should be emphasized that coccidiosis only becomes dangerous when heavy infestation, largely as a result of reinfection, is made possible by the system of poultry husbandry being followed. The chief losses from coccidiosis usually occur in chickens reared under artificial conditions; hence, such measures should be adopted as will promote vigour and active growth, and at the same time keep down the dosage of oöcysts, the complete elimination of which from commercial flocks is not practicable.

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References.

1. Minett, F. C., and Martin, W. J. Influence of mastitis and of *Brucella Abortus* infection upon the milk yield of cows. *Jour. Dairy Res.*, Vol. 7, p. 122. 1936.
2. Sanders, H. G. The variations in milk yields caused by season of the year, service, age and dry period, and their elimination. *Jour. Agric. Sci.*, Vol. 17, pp. 339, 502. 1927.
3. *The Farmer's Guide to Agric. Res. in* 1933, p. 39. (*Journal*, p. 207.)
4. *The Farmer's Guide to Agric. Res. in* 1933, p. 33. (*Journal*, p. 201.)
5. Maddock, E. C. G. Further studies on the survival time of the bovine tubercle bacillus in soil, soil and dung, in dung and on grass, with experiments on feeding guinea-pigs and calves on grass artificially infected with bovine tubercle bacilli. *Jour. Hygiene*, Vol. 34, p. 372. 1934.
6. Maddock, E. C. G. Experiments on the infectivity for healthy calves of bovine tubercle bacilli discharged in dung upon pasture. *Jour. Hygiene*, Vol. 36, p. 594. 1936.
7. Innes, J. R. M. The pathology of "Swayback": a congenital demyelinating disease of lambs with affinities to Schilder's Encephalitis. *Fourth Rep. Institute of Animal Pathology, Cambridge*, p. 227. 1934–35.
8. Stewart, W. Lyle. Swingback (Ataxia) in lambs. *Vet. Jour.*, Vol. 88, p. 133. 1932.
9. Murnane, D. Foot-rot in sheep. *Jour. of the Council for Scientific and Industrial Res., Australia*, Vol. 6, p. 252. 1933.
10. Marsh, H., and Tunnicliff, E. A. Experimental studies of foot-rot in sheep. *Montana Expt. Station Bull.* 285. 1934.
11. Beveridge, W. I. B. Foot-rot in sheep. *Jour. of the Council for Scientific and Industrial Res., Australia*, Vol. 8, p. 308. 1935.
12. Mohler, J. R., and Washburn, H. J. Foot-rot in sheep: its nature, cause, and treatment. *U.S. Dept. Agric. Bureau of Animal Industry, Bull.* 63. 1904.
13. Beveridge, W. I. B. A study of *Spirochæta Penortha* isolated from foot-rot in sheep. *Australian Jour. of Expt. Biology and Medical Sci.*, Vol. 14, p. 307. 1936.
14. *Rep. Select Committee of House of Lords on Agric.* (*Damage by Rabbits*), H.M.S.O., London, 1937.
15. Martin, C. J. Observations and experiments with *Myxomatosis Caniculi* (Sanarelli) to ascertain the suitability of the virus to control the rabbit population. *Fourth Report, Institute of Animal Pathology, Cambridge*, p. 16. 1934–35.
16. Tyzzer, E. E. Coccidiosis in gallinaceous birds. *American Jour. of Hygiene*, Vol. 10, p. 269. 1929.
17. Tyzzer, E. E., Theiler, H., and Jones, E. E. A comparative study of species of Eimeria of the chicken. *American Jour. of Hygiene*, Vol. 15, p. 319. 1932.
18. Bayon, H. P. *Diseases of Poultry* (Feathered World, Ltd., London, 1934).
19. Mayhew, R. L. Treatment of coccidiosis with powdered buttermilk. *Jour. Parasitology*, Vol. 20, p. 230. 1934.
20. Kerr, W. R., and Common, R. H. Effects of certain acid treatments in coccidiosis. *Vet. Jour.*, Vol. 91, p. 309. 1935.
21. Pérard, C. H. The biology of coccidia. *Rep. XII. Internat. Vet. Congress*, Vol. 3, p. 78. 1934.
22. Dalling, T., and Warrack, G. H. Coccidiosis of poultry. Supplement to *Eggs*, October, 1931.
23. Lamont, H. G. Coccidiosis in bovines and poultry. *Vet. Record*, p. 1028. 1935.

FARM IMPLEMENTS AND MACHINERY.

I.—Power Farming.

Most writers on the general topic of farm mechanization start by taking the view that there is nothing very new about the process: that it may be said to have started when prehistoric man first used a reindeer antler—or, in some versions, a fire-hardened stake—in his primitive soil tillage. There is, however, a sharp distinction between what is meant by "mechanization" to-day and what might have been meant had the term been used even, say, 75 years ago in the first golden age of implement development. We mean, in fact, the replacement, partial or complete, of animal power by mechanical power; of horses by internal-combustion engines or whatever new form of power may in time supersede them. Indeed, in these days when agriculture is no longer the self-contained, self-sufficient industry that it once was, the distinction can be put even more forcibly in another way: once agriculture used its own by-products as fuel for its power units; to-day it tends more and more to buy its fuels from outside the industry. This point is made by Wyllie (Ref. 1), who also discusses some of its implications. He goes on to give a careful analysis of the hourly working costs of a two-horse team and a small tractor respectively and, by considering the work which each may be expected to do, to conclude that "there can hardly be any question about the superiority of the tractor over the horse so far as operation costs are concerned." Wyllie, however, is careful to point out that individual operation costs are by no means the whole story and that many other factors must be considered if the question of machine *v.* horse is to be fairly and fully discussed. He also gives an interesting comparison between the working costs of a particular farm before and after the introduction of a tractor. Although there was a marked increase in the percentage of crops requiring a high labour input, there was a substantial reduction in the all-round costs per acre.

Carslaw and Culpin (Ref. 2) discuss the same general topic in a rather different way: by considering not individual cases but the average results for fairly large groups of farms. They

include a table showing the changes in the numbers of horses and engines of all kinds on British farms over the period 1908–31. Since the same kind of information was given and discussed in Wyllie's paper, it may be as well to point out that, as it stands, it is necessarily out of date. The important figures in the present connection are those relating to tractors. An unpublished enquiry by the present writer showed that, excluding War-time relics used for an odd hour or two of belt work, there were at least 30,000 agricultural tractors actually at work in the country twelve months ago, and that new tractors are coming into use at the rate of nearly 8,000 annually. It might be added that at present relatively few worn-out or obsolete tractors are passing out of use—rightly or wrongly, most of them are being patched-up for further service. Carslaw and Culpin also give an enormous amount of information about the average capital and running costs of equipment on farms of different size from 20 to over 500 acres. Their most interesting deduction is that while the gross output, calculated either per unit of man-labour costs or per unit of labour costs, rises sharply with size of farm at the lower end of the size scale, it becomes practically stationary after the 200-acre mark has been passed. Some of their other conclusions—and particularly those relating to the relative "efficiency" with which different implements are used—are not easy to accept as they stand. For example, because the number of acres per mower increases with the size of the farm, whereas the number of acres per farm cart remains stationary, they appear to conclude that, on the smaller farms, mowers are less efficiently used than are farm carts. They overlook the fact that while one cart is very like another the 7-feet tractor mower of the large farm is a very different machine from the 4 feet 6-inch horse mower which the smaller man employs. Nor can one agree with them when they suggest (apparently because tractors do not work for as many hours as they might) that "compared with industry, agriculture has yet far to go in its search for ideal power units." Applied to motor cars and railways a similar argument would lead inevitably to the conclusion that "compared with donkeys, human beings have yet far to go in their search for ideal methods of locomotion."

Incidentally, the idea that industrial power units are for ever working at full pressure is quite erroneous even in connection with mass-production methods. Moreover, it is fairly clear that in an industry which has such pronounced seasonal requirements as agriculture, the more immediately efficient any process or implement may be—in the sense of getting a particular job done quickly and cheaply—the more irregular its time-schedule will become. The same point has been often made in connection with man labour on mechanized farms, and is the subject of

a paper by Whitby (Ref. 3). He points out that mechanized wheat growing has reached a high labour efficiency when the crop requires only 14·2 man-hours per acre, but goes on to remark that some of the benefit is lost to the farmer if, for much of its time, the labour force has to be employed on jobs of doubtful production value. It should be noted in this connection that Carslaw and Culpin, in the introduction to their paper, remark that the success of mechanization "is measured by the consequent increase in man's production power and by the fact that this increase enables him to obtain his necessities with less effort, thus releasing energies to create and to consume an ever-widening range of luxuries in which leisure must be given a prominent place." If leisure for the farm labourer were more often considered there would be less talk of inefficiency and less of "jobs of doubtful productive value."

II.—Tractors.

Constant additions both to the range of available tractors and to the purposes for which they are used make it increasingly difficult for farmers to keep abreast of the situation. The choice of the best machine for a given farm is no longer simply a matter of reliability; it may involve all kinds of technical points, information about which is not always readily available. A prospective purchaser can get particulars of any one model, or even of all the different models manufactured by one firm, without much difficulty. But it is much less easy to get complete comparative information about all the machines of a given type—at any rate, without accumulating a mass of catalogues and other sales literature too great for comfortable digestion. In this connection a recent list of tractor specifications (Ref. 4), which covers all the models sold in this country and includes fairly complete particulars of type, power and price, is a considerable help. Still more complete information is given annually, for all current models which have at any time undergone a test at Nebraska, in two American trade publications—the *Tractor Field Book* and the *Red Tractor Data Book* (Refs. 5 and 6). In spite of their limitation to Nebraska-tested machines, these publications cover most of the tractors generally used in this country and include complete test data and detailed specifications.

The current issue of them also includes an analysis by Smith (Ref. 7) of all the tests carried out since the Nebraska Scheme was initiated in 1920. One of the points discussed is the variation that has taken place over the last sixteen years in the weights of tractors in relation to their power. Over the full period there has obviously been a steady reduction in the weight-power ratio, although, since he does not differentiate between wheeled and track-laying tractors, Smith's figures do not exhibit this fact

as clearly as they might do. Track-laying tractors necessarily weigh more than wheeled machines, and year by year comparisons of test weights are liable to be seriously affected by the relative numbers of wheeled and track-laying machines tested in any one period. For this reason a comparison made in 1934 by the present writer (Ref. 8), in which only wheeled tractors were considered, may be of interest.

PROGRESS IN WEIGHT REDUCTION.

(Figures based on all wheeled tractors tested at Nebraska in the periods stated.)

Period in which tested.	Fuel consumption on draw-bar rated load; lb. per h.p. per hour.	Test weight per maximum draw-bar h.p., lb.	Ratio of maximum pull to test weight.
1920	1·63	349	0·44
1923–26	1·15	275	0·62
1927–30	1·01	213	0·69
Current models	1·05	215	0·70

Smith points out that, taking an overall average for all the tractors of normal type, both wheeled and track-laying, that have been tested since 1920, the ratio of weight, in pounds, to maximum draw-bar h.p. comes out at about 250; and goes on to give an ingenious illustration of how such an average figure can be useful to farmers. He suggests that if the weight of any tractor, in pounds, is divided by 250, the result should be the maximum draw-bar h.p., *assuming that the tractor is of average performance and design.* In general, of course, the tractor will not correspond with the average and the h.p. figure deduced by this calculation will not correspond with the figure actually obtained in a test; but any marked difference between these figures will give an insight into the characteristics of the tractor and the work for which it is best adapted. If, for example, the calculated h.p. is appreciably less than the test figure, then the tractor is definitely light in proportion to its power, is likely to lack adhesion when conditions are difficult, and may be expected, in practice, to give its best performance in some gear other than the lowest. A difference in the other direction would indicate, on the other hand, that the tractor was best suited for heavy work in bottom gear. It is quite true that considerations of this kind might well be worth taking into account in the case of a new wheeled tractor which is being bought for use with existing implements; but it is suggested that an average weight-power ratio of 220 would give better results than the figure given earlier. In connection with fuel consumption, the same writer notes the great progress in economy that has taken place in the period under review, a point which again is perhaps more clearly demonstrated by th–

appropriate figures in the table given above. He also draws attention to two rather remarkable features: first, that there are wide variations in the fuel consumptions of current models operating on similar fuels; and, secondly, that, quite apart from the introduction and growing popularity of diesels, there is a distinct tendency in America for kerosene (paraffin) to give place altogether to petrol or distillate for tractor use.

The first point is illustrated by a tractor which, when tested in 1936, gave the extraordinarily low fuel consumption of 0·65 lb. of petrol per draw-bar h.p., as compared with an overall average for recent years of about 1·0 lb. This particular machine is not difficult to identify; it has a high-compression engine designed especially to run on high-octane petrol, and is geared for high-speed operation on pneumatic tyres. Two of its gear ratios give speeds of about 15 and 20 m.p.h. respectively, while in its standard 10 hours' draw-bar test (which is generally carried out in ploughing gear) the average speed was well over 6 m.p.h. From our point of view this machine is something of an oddity; yet it is fairly typical of one of the two lines of development in the U.S.A. which are resulting in the gradual disappearance of kerosene as a tractor fuel. In this connection two conditions which apply especially in America should be noted: first, that in that country petrol is not taxed nearly as heavily in relation to other agricultural fuels as it is here; and, secondly, that, although the terms kerosene and paraffin are generally regarded as being synonymous, they actually mean very different things when applied (in their respective countries) to tractor fuels. In this country tractor paraffin generally means a special vaporizing oil containing a considerable proportion of the more volatile petroleum derivatives. It is in effect a mixture of paraffin (or lamp oil) and petrol, and, as such, is considerably more volatile and, in ordinary circumstances, more efficient than lamp oil. In America, however, compound vaporizing oils are virtually unknown, and kerosene means lamp oil pure and simple. Distillate, which in turn is unknown as a tractor fuel here, is, on the other hand, intermediate between kerosene and diesel oil. It is appreciably cheaper than kerosene and not very inferior to it in performance.

The tendency in America, therefore, is very similar to what one would expect to happen here if the tax on petrol for agricultural purposes could be abolished. There would be no case for vaporizing oils, and users would turn either to petrol or to the cheaper grades of paraffin, according as to whether they considered low fuel costs, or high performance with low maintenance costs, the more important virtue. The particular conditions ruling in America are not, of course, likely to arise here. Nevertheless, the general tendency of American designers

of spark-ignition engines (Ref. 9) to concentrate either on high-compression power units operating on special high-grade petrols, or on units which will operate on really low-grade fuels, is not without interest to us because, except in the case of small wheeled machines, we still depend mainly on the U.S.A. for our tractors.

In this fuel controversy, three more or less distinct factors are concerned: high performance, which means roughly more power from a given size of engine; fuel costs, which depend partly on the economy of the engine and partly on the price of fuel; and, finally, crank-case dilution with its possible influence on depreciation. Barger (Ref. 10) discusses some comparative tests in which the five fuels commonly available in a small Middle West town were compared in each of two low-compression tractors originally designed to run on kerosene. Using the terms ordinarily used here, the fuels concerned were a really high-grade petrol, two lower-grade petrols, lamp oil and gas oil (distillate). The essential points brought out by these tests can be stated quite briefly. Except in regard to dilution there were no marked differences in performance. The petrols gave slightly more power than the kerosene and distillate, but to offset this the fuel consumption was rather higher. Incidentally, the high-grade petrol was no better in either respect than the lowest of the two other grades. Distillate gave the cheapest running costs—about 0·75 cents per h.p. hour as compared with about 1 cent for kerosene and low-grade petrol, and about 1·60 cents for high-grade petrol; these differences, however, depended much more on the relative prices of the fuels than on actual fuel economy. None of the petrols gave rise to appreciable dilution, while with both kerosene and distillate the dilution was of the order of 2 per cent. per hour. What these results amount to is that unless the engine is specially designed for it, there is no point in using an expensive high-grade petrol, while the economy and wisdom of using cheap low-grade fuels will depend entirely on whether dilution is regarded as important or not. Stated in the same simple terms, the present tendency in America is either to follow current motor car practice and design the engine specially to use high-octane petrols so as to get the maximum possible power from a given size of unit—and sometimes, but not always, the lowest possible fuel consumption; or, alternatively, to design the engine to run on the cheapest available fuels, regardless of the consequences of dilution.

In agricultural engineering circles in this country, on the other hand, dilution is regarded seriously as a potential cause of rapid engine wear. Black and the present writer (Ref. 26*a*) hold that faulty lubrication is easily the most common cause of high tractor repair bills, and that in practice the lubricating

qualities, even of high-grade oils, are only too often impaired by rapid dilution. This arises from the fact that paraffin or vaporizing oil is much less volatile than petrol. In consequence, although paraffin engines are provided with auxiliary devices for pre-heating the charge on its way from the carburetter to the cylinder, they are rarely able to vaporize and burn the fuel completely. Some of the heavier fuel fractions remain unburned and, after seeping down the cylinder walls, dilute the oil in the crank-case. Black suggests that the main cause of excessive dilution in practice is low engine temperature, and recommends that, after starting on petrol, a tractor engine should not be switched over to paraffin until the engine is thoroughly hot—that is, until the radiator water has reached a temperature of about 90°C.; while in subsequent running the temperature should be constantly maintained at about the same level by blanking off a portion of the radiator. Some recent comparative tests showed that when these precautions were taken, the dilution of a particular tractor after 24 hours' running was reduced from 25 per cent. to about 10 per cent. In practical terms, this result meant that, under the conditions of the test, temperature control could more than double the safe working life of the lubricating oil. Other opinion, however, does not agree that dilution is itself a primary cause of engine wear. Hardy (Ref. 11) describes the difficulties of tractor maintenance in Western Canada, where lubricating oil temperatures rarely exceed 130°–150°F. (55°–65°C.) except during the short mid-summer season, and are generally much lower. He points out that by far the most serious wear is that which takes place on the piston rings and cylinder walls, and remarks that faulty material, dust and dilution have all been blamed in turn. There is, however, no evidence that the materials of construction are at fault, while with the development of air cleaners, oil filters and other devices, dust has been practically eliminated from the modern engine. These changes have brought about considerable improvement, yet the wear which takes place inside the cylinder is still out of all proportion to that which occurs elsewhere. Hardy does not consider that dilution is responsible, and, in support of his opinion, quotes some British researches to which reference will be made later. An important point in his view is that the grade of lubricating oil should not be too heavy. He thinks manufacturers tend to recommend the use of unduly heavy oils so that there shall still be sufficient body in them when dilution has taken place. The result may be that, during the period when the oil is new or nearly so, it is too heavy to form the mist which is essential to cylinder lubrication, especially when the engine is starting from cold.

Everyone, however, appears to agree on one point: that

whether dilution has anything to do with wear or not, the period of starting and warming-up is the dangerous time. An Australian engineer, whom Hardy quotes, has estimated that 70 per cent. of all engine wear takes place during the period of no lubrication, that is, while the oil is being warmed up after a cold start. Other opinion, based on Canadian research, suggests that, in the case of an automobile, each start from 0°F. is equivalent to 130 miles of extra running.

The British researches referred to above were carried out some years ago by the Institution of Automobile Engineers on a single-cylinder stationary engine, and had as their sole object the investigation of the causes of cylinder wear (Ref. 12). The results indicated that by far the most important factor was the temperature of the cylinder walls and, provided this temperature was not below 100°C., neither dilution of the lubricating oil—even with up to 90 per cent. of kerosene; nor the presence of an appreciable amount of abrasive dust; nor, in fact, the almost complete absence of cylinder lubrication, led to any remarkable increase in cylinder wear. When, however, the cylinder wall was appreciably below 100°C., any or all of these causes might result in excessively rapid wear, and adequate lubrication of the upper cylinder wall became a matter of considerable importance. The results indicated, in fact, that the primary cause of wear was not abrasion but corrosion; and that the main contributing factor was the presence of condensation water.

It cannot, however, be assumed from these results that dilution, as such, is unimportant in agricultural tractors, for the experiments were concerned only with cylinder wear and, in the words of the report, "trouble was experienced with other working parts of the engine through continued operations with high degrees of dilution." And, in any case, there is one common moral to be drawn from all the papers quoted, namely, that the tractor engine should be run with the radiator water as near boiling point as possible. To this might be added that not only should an adequate starting period on petrol be allowed, but that this preliminary running should be done under load, and with the radiator shielded so that the engine is warmed up as rapidly as possible. Incidentally, since additional cylinder lubrication during the starting period would almost certainly be advantageous, a suitable proportion of lubricant—provided that it did not impede easy starting—might be added to the starting petrol.

Before leaving the question of tractor fuels, some mention may be made of the possibility of using producer gas, in which a certain interest is being taken in this country, mainly as a possible emergency measure. An enquiry on the subject, in which both wood and mineral fuels were considered, has been going on in Germany since 1931 (Ref. 13). For various reasons, however,

the conclusion was soon reached that only in a few special cases could gas be used with advantage as a tractor fuel, and the remainder of the work was confined to road transport or stationary engines.

Another American tendency which is not without interest here is the growing popularity of small general-purpose or, as we more often call them, row-crop tractors. Three papers on the requirements of such machines were contributed to a recent discussion by Benjamin, Orelind and Heitshu (Refs. 14, 15 and 16). They show clearly that the design of general-purpose tractors has been conditioned very largely by the requirements of crops such as maize and cotton, with which we are not concerned. Some of the general recommendations may, however, be noted. It is suggested that tractors intended for use as the main power units on farms of from 10 to 100 acres should be of three-wheeled type and of not less than 8 to 10 draw-bar horsepower, so as to be powerful enough to pull a 16-inch furrow in stiff land. They should be specially adapted for use with directly attached implements, and, in the case of row-crop equipment, all the hoes, except those which cut out the wheel tracks, should be mounted in front of the operator. Large diameter rear wheels are beneficial from the point of view of tractive efficiency, but they will often hinder a close attachment of tools and so make the outfit unwieldy.

One of the most interesting proposals relates to the use of the tractor for stationary work, such as grinding, sawing and pumping. If, instead of being driven by belt, these barnyard appliances could be designed to be driven from the power takeoff, the whole outfit would be very much more convenient. The usual type of power take-off is provided with universal joints and a telescopic shaft, and much time would be saved because there would be no need to line the tractor up exactly.

Finally, mention may be made of some further work on the optimum size and inflation pressure of pneumatic tractor tyres (Ref. 17), in which two new soil surfaces, both on a light blowing sand, have been studied. The paper referred to includes a table giving what is called the coefficient of traction for pneumatic tyres—that is, the ratio of draw-bar pull to static weight—on five different surfaces and with inflation pressures of 8 and 16 lb. per square inch respectively. On all types of agricultural surface the lower inflation pressure gave the highest coefficient. Both the highest and the lowest coefficients were recorded on light sandy soil—the highest figure of 79 per cent. on a dry, firm "wild" hay stubble and the lowest figure of 35 per cent. on an adjoining field which had been planted with maize, but which was suffering from wind erosion following a drought.

So far as tyre size is concerned, the position seems to be that

the greater the rear wheel weight the greater the available draw-bar pull, and, in consequence, the main advantage of a larger tyre is that more weight can safely be carried. It is suggested, however, that most users will not bother to adjust weights and tyre diameters so as to get the maximum possible draw-bar pull, but will be content to use the tractor more or less as it comes from the manufacturer.

III.—Cultivating Implements.

A more comprehensive account of some of the Cambridge cultivation researches, which were discussed in last year's number of *The Farmer's Guide*, has been given by Garner and Sanders (Refs. 18 and 19). On this occasion there were two main subjects for study: first, the preparation of a seed-bed for wheat after potatoes; and, secondly, the spring cultivation of autumn wheat. As has so often happened in cultivation experiments, there were very few significant differences in the yields following the various treatments, but in both cases the descriptions of the experiments are so full of practical detail that one feels that at any rate the experimenters themselves have collected some useful information. Indeed, in the case of the seed-bed preparation experiments, the authors for once stepped outside the rigid limits of statistical experimentation and drew some practical recommendations from their observations. These may be summarized by saying that they consider that, in general, ploughing is to be preferred to cultivating as the initial preparation for wheat after potatoes. Exceptions occur, however, when the land is rich and weak-strawed varieties are to be grown, in which case cultivating may diminish the risk of lodging; and when the land is so dry after potato lifting that no cultivations are likely to have much effect. In the latter case it is obviously cheapest to drill directly on the surface left when the potato haulms have been harrowed out. The main feature of the spring cultivation studies was that in eight experiments rolling never affected the yield significantly, although in some cases the land was so loose and open that any farmer would have considered rolling an absolute necessity.

Another aspect of rolling experiments is discussed by Culpin (Ref. 20), who deals with the methods which are being used to study the mechanical effects on the soil. Different methods are being used according as laboratory or field studies are in question. In one visual laboratory method the soil is built up in layers separated by sheets of tinfoil in a specially constructed box, and is compressed by a cylinder which closely resembles a section of the roll under consideration. By carefully removing each layer in turn, plaster casts showing the compression at various depths can be made. In another visual method the soil

is built in layers with thin layers of chalk between them. After the passage of the implement, blocks of the soil are "fixed" in a mixture of paraffin wax and naphthalene so that they can afterwards be sectioned. It is pointed out, however, that when the action of a Cambridge roll was studied in this way there was no visible effect at depths greater than 2 to 3 inches, although tests with a probe on the same soil showed that the action of the roll extended to at least 6 inches. Among other laboratory methods described are the use of buried pressure capsules and measurements of the withdrawal friction of buried metal rods. Neither of these gave results which could be repeated at will, but both indicated that the effects of rolling extended to much greater depths than were disclosed by visual methods. Culpin considers the friction method the more accurate, but the pressure capsules have the advantage that they give some sort of picture of what happens during the actual passage of the roll. In this connection it may be mentioned that experiments with the capsules indicated that during the passage of the roll the pressure rose to a maximum and then fell off after the roll had passed. Near the surface the maximum pressure was very high, but the final pressure was low; whereas at greater depths the maximum pressure was not so high, although the final pressure was sometimes higher than in the upper layers. When the roll was pulled over the buried capsule at high speed neither the maximum nor the final pressure was as great as at low speed.

The remainder of this paper deals with the methods used for measuring compression in actual field experiments, but since most of the material is also included in a second paper, further discussion will be left for the time being. In the meantime it may be noted that Culpin stresses the difficulty of reproducing in the laboratory any real parallel to soil conditions as they exist in the field. This difficulty is particularly great when moisture content is an important factor, for there is no satisfactory method of varying moisture content without at the same time altering other soil conditions. It will be interesting to see how far such considerations will affect the work of the new Government Farm Tillage Machinery Laboratory in the U.S.A. (Ref. 21). This most ambitious scheme provides for a number of permanent soil beds or bins, each of which is 250 yards long by 20 yards wide and 2 feet deep, and is filled with a representative type of soil. Any particular bed can be straddled by a power car equipped with a 135-h.p. engine, together with elaborate dynamometer equipment for measuring the reactions of the soil on the implements which are being carried or hauled. Means for watering, covering and grading the soil to a level surface are also provided. Among the problems which it is proposed to study are the effects of tools and implements on the tilth and soil structure; the

minimum amount of manipulation that will produce a satisfactory tilth; the power requirements of different implements; and the resistance of metals to wear; while, since each bin contains a different soil, the effect of different soil types on all these problems can also be examined.

An account of some preliminary work in this laboratory has been given by Reed (Ref. 22) and can be compared with an account of some rather similar work which has been carried out elsewhere under actual field conditions by Clyde (Ref. 23). In both cases the studies are confined to ploughs, while the measurements made up to the present have been concerned only with the forces on a plough when it is in work. It appears to be claimed that these are divisible into useful and parasitic forces respectively, but how the division is made, and consequently how far it is legitimate, is not at all clear. The practical results up to the present seem to relate only to such matters as the effect of speed on draught, the calculation of the bearing pressures on certain parts, and the determination of the best placing of the hitch; all of which could probably have been dealt with sufficiently accurately by much simpler methods.

Apart altogether from the obvious difficulty of simulating field conditions in a laboratory, however expensive and well equipped, it is difficult to conceive that tillage operations, and particularly ploughing, can mean very much if they are not closely associated with the growing of crops. It is reasonably certain, for example, that whatever theoretical calculations may be made about the proper hitching of ploughs, the actual setting in practice will always be judged and adjusted according to the quality of the work done. It would appear, in fact, that the Alabama project places rather too much emphasis on the purely engineering aspect of tillage and too little on the botanical, chemical and innumerable other aspects which together make up agriculture. This impression, however, may be a mistaken one due to the fact that the whole story has not yet been told; for other American writers on the subject of tillage appear to take as wide a view as one could wish for (Refs. 24 and 25).

In a further paper, which includes references to most of the Cambridge work already mentioned, Culpin discusses the bearing of mechanization on cultivation research (Ref. 26*b*). He points out that although mechanization has so far produced little change in traditional implements, it does in fact offer new and important possibilities of which the use of trains of implements in seed-bed preparation, the ability to perform really deep basal cultivations, and high speed operation are all examples. In any case where tractors are used the excuse which might formerly have been offered in support of any minor cultivation "that the horses might as well do so-and-so as stand idle" can no longer apply.

In the circumstances it may be pertinent to enquire what are the minimum cultivations necessary for producing satisfactory crops. His account, like those quoted earlier, deals with many experimental aspects besides conventional yield experiments. He points out, in fact, that "it is rapidly becoming clear that experiments in which various cultivations are performed, and only the final yields are compared, are little more than a waste of time unless we know something of how the implement affected the soil and how the soil conditions result in differences in yields."

In connection with the experiments on the preparation of the seed-bed for winter wheat, he mentions one large grower who considers a solid bottom so important for wheat on his chalky soil that he has constructed a specially massive press to produce it. Although it has not yet been possible to carry out a precise experiment to study the effect of this press, experiments carried out on the same farm on the effect of rolling with a heavy Cambridge roll before drilling gave no significant result, although tests of the resistance of the soil to the penetration of a steel probe and tests of the mass of soil per unit volume showed that the rolling had, in fact, compressed the whole of the ploughed land and, incidently, had eliminated the hollowness between the furrow slices and the subsoil. In a further attempt to produce a definite result some small-scale experiments were carried out covering a series of extreme treatments, varying from a seed-bed which had been deeply forked and left as fine and loose as possible, to a seed-bed from which 2 inches of soil were removed, the bottom rammed as solid as possible, and the top soil replaced and rolled. Measurements with a probe and otherwise showed that enormous differences in consolidation had been produced and that these persisted right up to harvest time. Nevertheless, there were no significant differences in harvest yields, although differences in tiller counts had appeared in the earlier stages.

Again, in connection with experiments on spring cultivation of wheat, Culpin mentions that in spite of their earlier experimental results Garner and Sanders were not satisfied that rolling was a waste of time, and sought other soils on which positive response might be gained. Their further efforts were more successful. In 1934–35 they had an experiment on a light, thin, chalky soil and obtained their first positive result in favour of spring rolling. The experiment was successfully repeated in 1935–36, while, in the same year, a further trial on Fen skirt soil only just failed to give a significant increase.

Culpin goes on to describe some soil studies which were made in 1935–36 on these same soils. On the light, chalky soil, autumn and spring rolling respectively were compared with no rolling on a crop of Little Joss wheat taken after a seeds ley. When the soil was tested in November it was found that the autumn

rolling had consolidated the ground to a depth of 4 inches. In March this effect still persisted to a depth of 3 inches, whereas spring rolling was most effective at the surface and had a significant consolidating effect only down to 2 inches. In other words, autumn rolling consolidated the whole furrow, while the effect of the spring rolling was superficial. At harvest time, however, the effects of spring rolling were still apparent, but the effects of autumn rolling were no longer significant. The spring rolling produced a 20 per cent. increase in the yield of grain, but the autumn rolling had no such effect.

On the Fen skirt soil the following treatments were compared :—

(1) Rolling in February.

(2) Rolling in February, horse-hoeing and harrowing twice in April and May.

(3) Control (no spring cultivation).

Treatment (2) was the normal procedure adopted on the particular farm concerned. Penetration tests showed that, a week after the rolling, the soil was consolidated to a depth of over 4 inches on plots (1) and (2). After the horse-hoeing and harrowing, the consolidation effects persisted only down to 2 inches. At harvest time, consolidation on the rolled plots was significantly greater than those on the controls over the top 2 inches, while the horse-hoed plots were similar to the rolled ones, except that they had a layer of mulched soil at the surface. Other tests showed that, three months after the rolling treatments had been performed, a well marked compressing effect could be demonstrated by sieving. Where the compression was greatest the soil particles were stuck together in larger crumbs. Tests of the moisture content showed no significant differences except that at a depth of 2 inches the moisture content was higher on the rolled plots than on the controls. Culpin doubts whether this higher moisture content is evidence of the soil's increased ability to draw water from below ; it may possibly have been due to an increased capacity to retain water received in the form of rain.

This paper was one of a series of three on cultivation problems which were contributed to the Second Oxford Conference on Mechanized Farming. On the same occasion, Keen (Ref. 26c) discussed the scientific basis of the art of cultivation, mainly from the point of view of control of soil moisture. He gave an account of the " capillary-tube " theory and of the experiments which led to its abandonment. He pointed out that the newer ideas on the subject suggest that most soils are, in fact, self-mulching and that cultivation operations can no longer be expected to exercise anything like the delicate control of soil moisture once attributed to them.

Moisture control of a less delicate nature is discussed by

Drake (Ref. 28), who deals mainly with the problems which exist in those parts of the U.S.A. which are subject to erosion. The problem there is not to bring hypothetical moisture from below but to prevent it from running-off on the surface; and in these circumstances proper cultivations can be really effective.

The third paper in the Conference series was by Amos (Ref. 26*d*) and gave a farmer's criticisms of the two preceding ones. Briefly, his main criticism was that modern experimental technique is too rigid; that too much reliance is placed on yield experiments; and that the overwhelming effect of the farmer's art in practice is generally overlooked in experiments. Finally, he appealed for more qualitative and less quantitative experiments. However, in view of the altogether wider outlook of the papers quoted in this article, it is doubtful whether Amos' criticisms—or, for that matter, those which were developed in last year's *Farmer's Guide*, can any longer be justified. On the other hand, it is becoming increasingly likely that tillage has a "rotational" significance; that cultivations which serve no apparent immediate purpose may nevertheless be vitally important from a long-term standpoint. Some consideration has been given to this point by Skilbeck (Ref. 26*e*) in an introduction to a discussion on fertility maintenance. The discussion itself suggested that some of the farmers present were fully in accord with his views (Ref. 27).

One other paper which, if not definitely concerned with cultivation, is on a subject very closely connected with it, may be mentioned (Ref. 29). It deals with research on fertilizer placement and gives a summary of experiments with 13 crops at 49 places during 1935. It seems evident that fertilizer is of the greatest benefit to the crop when applied in a band at each side of the plant row at a position approximately 2 inches to the side of the plant and about 3 inches below the surface of the ground. Fertilizer placed directly under the seed caused early injurious effects in many cases, and when the fertilizer was broadcast results in all instances were decidedly inferior to comparable sowings at the side of the row. But results from fertilizers depend on various conditions, and no particular fertilizer placement has been invariably the best under all conditions. Progress has been made in the development of the necessary machinery for the side-drilling of fertilizer for a full range of crops, and attention has been extended to transplanting machines. The article includes illustrations and descriptions of some of these machines.

IV.—Harvesting and Haymaking Machinery.

There have been no striking developments in either harvesting or haymaking appliances during the last year, and the papers

to be dealt with are concerned mainly with farmers' own experiences of existing equipment. A very informative and comprehensive bulletin on harvesting with combines has, however, been issued by the U.S. Department of Agriculture (Ref. 30). It discusses in great detail the construction, operation and maintenance of combine equipment and deals also with the use of the method with many different crops. It is interesting to note that these include, besides ordinary cereals, flax, peas and beans, as well as grass and clover seeds.

Hosier (Ref. 26*f*) has given an account of his first year of combine harvesting, in which he used two different machines—a 10-feet Combine of standard type, and a 12-feet Australian header. The header was particularly useful where straw straight enough for thatching was required. It was set so as to take as little straw as possible, and was used in conjunction with a left-hand binder. The latter, of course, travelled the opposite way to the header and so met the slanting straw. Big bundles were made and " the straw in them was as straight as reeds and quite suitable for thatching without yelming." It may be of interest to explain how the header manages to take the heads only, even when, as often happens, the height of the standing grain varies considerably. The secret is a roller which extends the full width of the cutter bar and can be set so as to keep the higher heads from the knife until they have been bent down to the level of the lower ones. The trouble which all combine users experienced last year from an excess of damp greenstuff in undersown crops was overcome on this farm by turning the hot exhaust from the combine engine into the machine. It did just enough drying to wilt the greenstuff and prevent blocking. Hosier mentions one point of interest in connection with the ploughing-in of the long stubble left by the standard combine. He usually ploughs round and round from the outside, and remarks that if the combine (or presumably the plough) had a left-hand cut the two implements would travel the same way, so that the stubble would be slanting in the right direction for easy burying.

A general account of combine harvesting during 1936 has been given by Newman (Ref. 26*g*). He compares the average output of six " baby " Combines with that of eleven standard machines. The former averaged 125 acres per machine (5-feet cut) or 25 acres per foot of cut. The larger machines, whose cutting widths varied, averaged 22·6 acres per foot of cut. The crops consisted mainly of wheat and barley, but oats, rye, beans and mustard were also dealt with. The largest daily output on any one farm was 325 quarters of wheat by two machines in Norfolk. This account also discusses windrowing and the work of a new German machine which thrashes the grain and also ties the straw. The most notable feature was the unusual arrange-

ment of the cleaning mechanism: the chaff was sucked up and blown out before the grain reached the riddles, so that the work of the latter was made much easier.

As has been mentioned earlier, combining and, in fact, all harvesting was complicated in 1936 by an excessive growth of greenstuff. In several instances combines were set to cut as high a stubble as possible, and a mower was afterwards run over the field. The resulting mixture of short straw and clover was swept up and stacked, and made a very palatable and useful feed.

One other paper on combine harvesting may be mentioned: a Canadian analysis of costs (Ref. 31). From data relating to 63 machines it is deduced that at least 700 acres must be harvested annually with a 15–16-feet machine, or 525 acres with a 10–12-feet machine, if reasonable costs are to be secured. Since these acreages represent roughly double what is generally achieved in this country, it should be emphasized that the costs referred to are costs per quarter and not per acre.

Except in the north the weather during our haymaking seasons is, on average, just too good to create any sustained interest in tripod or rack methods of field drying. Actually, however, such methods ought not to be regarded only as safety measures for use in unfavourable seasons, but as means for producing a better-quality product in perhaps four seasons out of five. The Scandinavian "hässjor," or hay-rack, is described in a note by Bodfan-Griffith (Ref. 32). The racks consist of wooden uprights (stakes 7–9 feet long) which are set 3–4 feet apart, and support four horizontal lines which may be of wire or tarred hemp. The hay is hung on these racks, rather like washing on a line, so as to form what are in effect long narrow cocks. A four-line rack holds up to 1 cwt. of dry hay per yard run, and five men can make and cover racks just fast enough to keep pace with an ordinary horse-mower. Clover is hung up immediately after cutting, while grass should first lie for a few hours. In good weather the crop will dry in 2–3 days; in bad weather it will be safe for weeks. The working costs, including materials, are estimated at rather under 5*s*. per ton of hay; the product is said to be comparable with artificially-dried grass.

The natural drying of forage crops is dealt with by Jones and Palmer (Ref. 33), who set out very clearly the physical and botanical factors involved and discuss some of their engineering implications. With lucerne, clovers and similar crops the main difficulty is that the leaves dry much more rapidly than the stems; and the most hopeful solution appears to be something on the lines of the mower-crusher which has been referred to in former years. A machine of this type costing round about £250 is likely to be marketed in the near future. The shattering of lucerne leaves is also dealt with by Zink (Ref. 34). Shattering,

with its consequent loss of quality in the final product, is most pronounced when the moisture content of the leaves is round about 10 per cent. In the field shattering was most serious during the middle of the day; in the evening, when the atmosphere was more humid, the leaves toughened and losses were reduced. It is suggested, therefore, that, in dry weather, tedding and similar operations which are mainly concerned with promoting stem drying, should be carried on at night; in fact, night haymaking is said to be a common practice in Arizona.

V.—Grass Drying.

A very comprehensive account of the present position of grass drying in this country is given in an Agricultural Research Council Report by Roberts (Ref. 35). During 1936 there was a four-fold increase in the number of driers at work, and several new types of plant made their appearance. The kind of farm on which artificial drying has been taken up is illustrated by figures relating to 26 holdings. Their average size was 657 acres; individual farms varying from 152 acres to 3,000 acres. Two-thirds of the farms were engaged, wholly or partly, in producing milk for sale, while the average stocking over the whole area concerned was 24 cattle and 32 sheep per 100 acres. Apart from experimental farms and aerodromes, grass drying was more or less confined to large dairy farms and to well-to-do farmers; in fact, as Roberts points out, "only 13 per cent. of the producers were of the type who bought their grass-driers with money made out of farming." Actual drying experiences varied with circumstances. The season was a very difficult one on account of wet weather and, on the whole, the outputs from most of the plants were disappointing. Under the prevailing conditions few of the farm driers were capable of averaging as much as 3 cwt. of dried grass per hour, but to some extent the low outputs may have been due to inexperience. The largest total production over the full season was 329 tons on a farm on which day and night shifts were regularly engaged. The report describes in some detail seven different types of plant. They include two of the tray type; three of the endless belt or conveyor type; one revolving drum drier; and one pneumatic drier. So far as the main principle of blowing hot air from a furnace through or around the wet grass is concerned, all these driers are similar. They differ mainly in the way in which the material is conveyed or handled during the actual process. Thus, in a tray-type machine grass is dried in batches and is tedded or transferred by hand at a halfway stage. Most of the others are continuous in operation and either provide for some kind of mechanical tedding or dispense with it entirely. At the moment it is impossible to make any valid comparison between these different types. For one

thing, few of them have yet been in operation over a full season, while, in most cases, the design is still being modified as more experience is gained. It is sufficient to say that, with efficient handling, all of them are capable of turning out a satisfactory product. On the other hand, none of them is foolproof—nor, indeed, is any future drier likely to be so.

The future of grass drying—at any rate, as a farm operation—clearly depends on costs in relation to the value of the dried product; and on the ease or difficulty with which the process can be fitted in with normal farm routine. For information on the latter point reference may be made to three papers, describing farmers' own experiences with drying, which were read at the Oxford Conference (Refs. 26*h*, 26*j* and 26*k*), and to an account of the discussion which followed (Ref. 27). In this stage of development, of course, every farm is a particular case and it is difficult to draw any general conclusion; but, making all due allowance for enthusiasm, there would seem to be no great difficulty in managing a drier without upsetting the remainder of the farm economy. Managing the grassland itself may be more difficult; with the small-capacity machines now available it is almost impossible to keep pace with the early summer flush of grass, and the producer has generally to choose between turning out a low-grade product, costing more than it is worth, and the alternative of abandoning his drier temporarily in favour of haymaking. Many different questions affecting this difficulty are discussed in the papers quoted above—particularly in the A.R.C. report—but no satisfactory solution has been found. On the complementary questions of costs and the value of the dried product there is much difference of opinion. Roberts analyses the costs of working driers at 12 centres fairly fully, while Dixey and Askew (Refs. 26*l* and 36) discuss in greater detail the figures collected on five farms. It is interesting to note that the costs given by farmers themselves for their own working are often appreciably lower than those deduced by economists from a more comprehensive survey. However, on this occasion there is little room for argument since the average costs given in the A.R.C. report agree extraordinarily closely with those given by Dixey and Askew. The overall cost per ton of dried product was £5 17*s*. 5*d*. in the one case and £5 18*s*. 6*d*. in the other. The main items making up these costs were labour, which accounted for from a quarter to a third of the whole; fuel and power, which accounted for rather more than another quarter; and depreciation. The differences of opinion arise when any attempt is made to compare these costs with the value of the dried product. Dried grass has commanded a ready sale off the farm—mainly to the feeding stuffs trade—at prices generally ranging from £7 to £8 per ton, but sometimes reaching £11; but whether

these figures represent anything like a steady value or are due mainly to an almost universal desire to "give the stuff a trial" is not easy to decide. Making an impartial comparison with other feeding stuffs, Roberts assesses the value of good quality dried grass, containing 17 per cent. crude protein, at about £6 15*s*. per ton; but points out that this figure makes no allowance for carotene. He remarks that "at this price, the product shows a poor profit on a production of about 150 tons, the use of about £1,000 capital, and of about 70 acres of land." Incidentally, it should be noted that relatively few samples last year contained as much as 17 per cent. protein. Of 46 samples from permanent pastures recorded by Dixey and Askew, only one gave a protein content of more than 16 per cent., while the majority were below 14 per cent. Three samples from temporary leys gave 13, 15 and 20 per cent. protein respectively.

More important, however, than the present margin between the cost of producing dried grass and its value as a feeding stuff are the prospects of effecting an improvement in the future. At first sight there would appear to be three main lines of attack: reducing the cost of the wet grass as delivered to the plant; reducing the actual cost of drying by improving the drier itself; and raising the quality and, therefore, the value of the product. Actually, however, the efficiency of the drier itself is the main controlling factor. For the cost of the wet grass is made up partly of items like rent and fertilizers, which are outside the farmer's control, and partly of labour for cutting and delivery. The latter item may in some cases appear to be unduly high, but it generally involves only what is, in effect, a minimum and indivisible unit—for example, one man and a tractor. It is possible that the same team could cut and deliver much more grass than they actually do in the same working time; but nothing will be gained if the drier cannot cope with the larger quantity. Again, while there is much to be said for growing better grass for drying, this would generally increase management costs, and although potential quality would be improved, the fact would remain that in practice the limit to average quality over the season is set more by the capacity of the drier and its ability to cope with the June flush than by any other factor.

So far as the drier itself is concerned, the problems are to increase the output for a given capital cost; and to lower operating costs by reducing the labour required and by increasing technical efficiency. As Roberts points out, an output of "2½ cwt. per hour is too little to attract the large farmer; on the other hand, the capital that was required to obtain that output last year was one that only a large farm could support." He goes on to suggest that for every £100 rent, or annual value of a farm, the output should not be less than 1 cwt. per hour for the size of

drier that the farmer can afford. Whether the capital cost of equipment can be reduced to meet this demand is too complicated a problem to discuss here. It seems reasonably clear, however, that no spectacular increase in technical efficiency is to be hoped for. There is a limit to the amount of water that can be evaporated by a given amount of fuel, and it appears that this limit is already closely approached. Newman (Ref. 37) discusses the question at some length, and at the same time compares the different methods of drying that are practised. He concludes that driers have already reached a high pitch of efficiency, comparable with that of any industrial drying process excluding vacuum drying and plants which utilize waste heat. Nor does he consider that labour costs can be greatly reduced.

It would appear, then, that only one real possibility remains: to reduce the quantity of water that has to be evaporated by the machine by securing some preliminary wilting in the field. The engineering arguments in favour of preliminary wilting are enormous; and although, with existing equipment, difficulties of collection would arise, these are by no means insuperable. Let the desirability of preliminary wilting be generally recognized and equipment for dealing with the product will soon be forthcoming. As to the effect of wilting on the feeding value, the relevant figures are outside the province of this article. Carotene is the constituent mainly affected—and carotene is the factor on which the enthusiasts rely to justify the high value which they put on the product. One cannot help feeling, however, that our live stock have had to manage without this extra carotene in the past and that if there had been a real demand for it it would by this time have been sold in bottles.

VI.—Machinery for Root and Vegetable Crops.

It has been stated often enough that tractors are used somewhere in this country for every normal farming operation which is ordinarily performed by horses. In the case of preparatory cultivations, haymaking, grain harvesting and a host of other operations, the statement is clearly true; the necessary tractor equipment can be bought, practically over the counter, and only a minimum of experience is necessary for completely successful working. In the case of after-cultivations of row crops, the statement is still true; but in a rather different sense. The range of crops is large; even with a single crop there are wide variations in row widths and spacings; while the work generally is likely to be effected by local variations both in soil and in farm routine. For all these reasons there is, as yet, no such thing in this country as standardized row-crop equipment and consequently there is still room for a good deal of individual ingenuity. Rockcliffe (Ref. 26*m*) and Baker (Ref. 26*n*) describe their own experiences

in adapting tractors for the cultivation of potatoes and sugar beet respectively. Rockcliffe started by trying to adapt his horse implements to the tractor, but gave up the attempt partly because an extra man was required for satisfactory implement control and partly because the outfit required an unduly large headland. Finally he fitted his tractor with a standard power-lift tool bar to which a whole range of implements could be attached as required. He also had a differential brake fitted which enabled his tractor (which was of the three-wheeled type) to make a full right-angled turn. Some of the implements used were made to his own designs. Rockcliffe considers that although he cannot afford to dispense with horses, and in consequence has no intention of completely mechanizing his potato crop, he nevertheless gains a considerable advantage by using special tractor equipment for intermediate cultivations. One incidental advantage is a smaller headland which allows him to grow at least half an acre more than he could with horses. Baker's evolution of a satisfactory hoe equipment for sugar beet was a rather more gradual process. He used a "baby" row-crop tractor throughout, and started with a four-row hoe rather on the lines of the American designs which have already been mentioned (Refs. 14, 15 and 16). This was fairly satisfactory in work, but was uneconomical, as it covered only some 12 acres per day. It also had the disadvantage that the wheels of the tractor pushed some of the rubbish back into the ground. The next step was a modified four-row unit followed by two four-row horse-hoes—these being pulled by the tractor and arranged one on each side of the main unit. This would do 30 acres a day, but was very hard on the steersman, who had to walk behind the auxiliary units. By providing seats for the steersman this difficulty was overcome, and the rate of working was pushed up to 45 acres a day; but the outfit was unwieldy and required too much turning space. The final compromise was the modified four-row tractor unit with extra two-row units on each side; the whole gang of hoes for eight rows being coupled so as to be easily lifted and controlled by the tractor driver. This outfit averaged four acres per hour and did excellent work on 250 acres of beet throughout the 1936 season. Mechanical lifting was done with lifters of the two-share type, taking two alternate rows at a time so as to make it easier to avoid blocking.

Both Baker and Rockcliffe stress the importance of careful preparation of the land and good drilling. A really level surface and really straight rows are at least as important to good work as the efficiency of the hoe equipment itself.

American developments in sugar beet mechanization are described by Mervine and McBinney (Ref. 38). Experiments on both spaced drilling and gapping by cross-hoeing have been

carried out with a view to reducing the labour peak at singling time. Spaced drilling effected a considerable saving of seed, but relatively little saving of labour for singling. In fact, on some soils spaced drilling actually increased the labour required for singling because the germination was improved. Cross-hoeing was more successful, and a technique has been evolved which reduces singling labour without impairing the final stand. It may be mentioned that similar work, not yet published, has been going on for some years in this country and has reached similar results. Spaced drilling has also been studied from another point of view—that of getting a more uniformly spaced final plant on which experimental harvesting machinery may be expected to have a greater chance of success. The results, however, are not very encouraging because, however accurate their general work may be, all spacing drills deposit occasional odd seeds at irregular intervals. At singling time, unless very careful supervision is exercised, the plants from these odd seeds (rather than plants from correctly spaced bunches) are left, so that the final spacing is no more regular than before. The American work also refers to developments in harvesting machinery, and to an experimental topper-lifter which has been in gradual evolution for several years past. It differs from most other machines of the kind since it pulls the roots out by the leaves—using a pair of rubber-faced elevating chains which grip the beet after it has been loosened by a lifting share. This has the advantage that the beet can be conveyed to a sort of gauge which works against the crown of root and controls the accuracy of the topping. Under rather favourable conditions the machine gave very good results. The gain in dirt tare more than offset a small loss in top tare; while the overall losses due to the machine were in turn offset by a gain in root weight due to the convex shape to which the machine-topped roots were cut. The machine weighs about a ton, and can be easily hauled and driven by a 20 h.p. tractor.

It is clear that so long as root crop mechanization is confined to the replacement of horses by tractors, the increasing difficulty of getting sufficient seasonal labour will remain. The serious matter now is not so much to save labour in hoeing—although this may be very desirable from an economic view—but to reduce the hand-labour requirements. In the case of ordinary root crops which are sown and singled, very little progress in this direction has yet been made. In the case of transplanted vegetable crops, on the other hand, one grower at least has achieved some measure of success (Ref. 26*p*). This grower has experimented with transplanting machines of both the fully-mechanical and semi-mechanical type, and has finally designed his own outfit. It is claimed that, except on very wet soils, machine planting is definitely superior to hand work, the roots being better placed and

more firmly pressed in. Machine planting, however, is never regularly spaced, so that, since subsequent cross-hoeing is impossible, some mechanical device for inter-plant hoeing is necessary if full advantage is to be taken of the greater acreage that the machine planter can handle. In this particular case the difficulty has been got over by an ingenious pneumatic gapping hoe.

Finally, the reactions of two Continental countries to root crop mechanization may be of interest. In Russia (Ref. 39), where there is a special Scientific Institute for Vegetable Cultivation, there is little evidence of any spectacular new equipment. Their work aims rather at producing standardized equipment for all cultivations, from the first ploughing onwards, so that crop production can proceed more or less by rule of thumb, and mechanization can be effected even where no skilled labour is available. A French article, on the other hand (Ref. 40), contains a vision of a highly intelligent machine of the future which will top and lift sugar beet with complete uniformity even though the plants themselves are irregular. The article opens with a reasoned account of agricultural labour difficulties which, in France, are aggravated by the fact that a 40-hour week is becoming universal in industry. Any general change to easily mechanizable crops is out of the question and, in particular, the cultivation of sugar beet must be preserved "to avoid disastrous imports of sugar" and to secure the manufacture of explosives and alcohol. It is pointed out that the general failure of sugar beet mechanization is due to the fact that the crop requires discriminative handling at various stages, and especially at harvest time. The necessary measure of discrimination might be provided mechanically by using "an electric eye"—in other words, a selenium cell. The article goes on to envisage a beet topper and lifter of the future controlled by a selenium cell which, being contrived so as to be sensitive to green and insensitive to brown, can distinguish between leaves, crown and soil, and can therefore treat each individual beet on its merits. A fanciful idea indeed, but possibly no more fanciful in its generation than the first knotting mechanism must have seemed a hundred years ago.

VII.—Miscellaneous.

Two further reports on the Wye College spraying machinery investigations have been issued (Ref. 41). These are both concerned with detailed studies of nozzle design, and in particular with the factors which affect "carry" and output. The immediate object of the work has been to design equipment and work out a technique by which the measurements necessary for comparing one nozzle with another can be made accurately, and independently of the "judgment" of the observer. Until accurate

measurements can be made there can, of course, be little hope of giving the design of any piece of equipment a scientific basis, and from this point of view the work described here should eventually be of the utmost value both to manufacturers and growers. Two particular points that are touched upon are the increased range that can be secured by using multiple nozzles and the relative merits of spray guns and fixed nozzles. The type of work done by spray guns is capable of adjustment between wide limits without interference with the continuity of the work itself. Against this advantage must be set the fact that they require more skill in use and so with "average" labour may lead to less efficient spraying. This defect can, however, be got over by changes in design; and descriptions are given of two almost fool-proof guns which were evolved during the course of the research.

One of the newest ideas in connection with electricity in agriculture is the electric fence. A single wire charged with an intermittent current at about 12 volts is said to retain all types of stock as securely as any barbed wire fence. An American report on the subject (Ref. 42) refers to various types of equipment operating on direct current voltages of 6 and 32 volts or on an alternating current of 110 volts. The latter allows of "mains" operation and is presumably used with a transformer. In the case of one 6-volt set, four ordinary dry batteries are said to handle five miles of fence for two months. The report deals mainly with the results of a questionnaire addressed to some of the 5,000 known users of the method, and states that most of the replies "sound too much like cosmetic testimonials to present to a technical society"—evidently most of the users were well pleased with their outfits. One reply in particular is worth quoting: "Have weaned mule colts from mares with two wires." Since this question is closely related to the question of the potential danger of electric shocks—about which little accurate information is ordinarily available—a reference to a recent note on the subject (Ref. 43) may not be out of place. Subject to various qualifications regarding the exact circumstances of contact, the minimum voltages that may prove dangerous are given as 65 volts for human beings and as little as 24 volts for some domestic animals.

Another unusual use of electricity is in fighting insect pests. A series of German articles (Ref. 44) deal with this subject very fully under three headings, which cover the use of electricity: (1) as a means of killing and keeping off insects; (2) as a means of trapping them; and (3) as a means of driving apparatus for catching and collecting them.

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References.

1. Wyllie, J. Machine versus Horse. Incorporated Society of Auctioneers and Landed Property Agents.
2. Carslaw, R. McG., and Culpin, C. Labour, power and equipment in arable farming. *Journal R.A.S.E.*, 1936, p. 12.
3. Whitby, H. Labour requirements on a mechanized wheat farm. *Scottish Jour. Agric.*, October, 1936, p. 349.
4. Tractor specifications. *Farmer and Stockbreeder Year Book*, 1937, p. 258.
5. The Tractor Field Book, 1937–38. *Farm Implement News*, Chicago.
6. The Red Tractor Data Book, 1937–38. *Implement and Tractor*, Kansas City.
7. Smith, C. W. An analysis of Nebraska test data. *The Red Tractor Data Book*, 1937–38, p. 103 (see above).
8. Wright, S. J. Some features of modern tractor design. *Jour. Inst. Automobile Engineers*, 1934, p. 195.
9. The tractor industry. *Implement and Machinery Review*, June, 1937, p. 191, and July, 1937, p. 280.
10. Barger, E. L. Comparative tests of fuels in low-compression tractors. *Agricultural Engineering*, July, 1937, p. 311.
11. Hardy, E. A. Tractor engine lubrication under low temperature. *Agricultural Engineering*, November, 1936, p. 465.
12. Cylinder wear. *The Engineer*, June 23rd and 30th, 1933; July 27th and August 3rd, 1934.
13. Kuhne, G., and Koch, F. Holz und Holzkohlengaserzeuger für Kraftfahrzeuge, *Heft* 60 *der R.K.T.L. Schriften*, 1935.
14. Benjamin, B. R. Farm requirements of the small all-purpose tractor. *Agricultural Engineering*, May, 1937, p. 209.
15. Orelind. J. R. Requirements of the small all-purpose tractor from the implement engineer's standpoint. *Ibid.*, p. 211.
16. Heitshu, D. C. Requirements of the small all-purpose tractor from the implement engineer's standpoint. *Ibid.*, p. 213.
17. Hurlbut, L. W., and Smith, C.W. Effect of tractor tire size on draw-bar pull and travel reduction. *Agricultural Engineering*, February, 1937, p. 53.
18. Garner, F. H., and Sanders, H. G. Investigations in crop husbandry. IV. The preparation of the seed-bed for wheat after potatoes. *Jour. Agric Sci.*, 1936, Vol. XXVI, p. 415.
19. Garner, F. H., and Sanders, H. G. On the spring cultivation of autumn wheat. *Jour. Agric. Sci.*, 1937, Vol. XXVII, p. 447.
20. Culpin, C. Studies on the relation between cultivation implements, soil structure and the crop. III. Rolls: an account of methods employed in a study of their action on the soil. *Jour. Agric. Sci.*, 1937, Vol. XXVII, p. 432.
21. Randolph, J. W., and Reed, I. F. The farm tillage machinery laboratory. *Agricultural Engineering*, June, 1935, p. 219.
22. Reed, I. F. Tests of tillage tools: I. Equipment and procedure for moldboard ploughs. *Agricultural Engineering*, March, 1937, p. 111.

23. Clyde, A. W. Load studies on tillage tools. *Agricultural Engineering*, March, 1937, p. 117.

24. Trullinger, R. W. The fundamental approach to tillage and traction research problems. *Agricultural Engineering*, January, 1937, p. 17.

25. Jones, G. D. Rootbed *versus* Seedbed. *Agricultural Engineering*, May, 1937, p. 207.

26. Papers read at the Second Oxford Conference on Mechanized Farming, 1937. (Institute for Research in Agricultural Engineering, University of Oxford.)
   - (*a*) Wright, S. J., and Black, E. B. Tractor performance in theory and practice.
   - (*b*) Culpin, C. Some modern cultivation problems.
   - (*c*) Keen, B. A. The scientific basis of the art of cultivation.
   - (*d*) Amos, A. A farmer's views on cultivation experiments.
   - (*e*) Skilbeck, D. An introduction to the discussion on the maintenance of fertility.
   - (*f*) Hosier, A. J. My first year with combine harvesters.
   - (*g*) Newman, J. E. A review of combine harvesting in 1936.
   - (*h*) Chambers, J. E. Grass drying on a mixed farm with a Ransome drier.
   - (*j*) Bazley, A. G. Grass drying with a Curtis-Hatherop drier.
   - (*k*) Vaughan-Williams, R. Notes on grass drying on a dairy farm (I.C.I. drier).
   - (*l*) Dixey, R. N., and Askew, R. P. The production of dried grass and its cost : some preliminary observations.
   - (*m*) Rockcliffe, F. W. Tractor cultivation of potatoes with row-crop attachment.
   - (*n*) Baker, W. Newcome. Row-crop cultivations of sugar beet.
   - (*p*) Bomford, D. R. Row-crop equipment.

27. Report of discussions at the Second Oxford Conference on Mechanized Farming (see above).

28. Drake, R. W. Soil moisture conservation. *Agricultural Engineering*, January, 1937, p. 15.

29. Cummings, G. A. New developments in fertilizer placement research. *Agricultural Engineering*, November, 1936, p. 461.

30. Harvesting with combines. *Farmers' Bulletin No.* 1761. U.S. Department of Agriculture.

31. Grest, E. G. The combine harvester. *Scientific Agriculture* 15 (1934), No. 4, p. 244.

32. St. Bodfan-Griffith, J. Quick drying of hay. *Jour. Ministry of Agriculture*, July, 1937, p. 311.

33. Jones, T. N., and Palmer, L. O. The natural drying of forage crops. *Agricultural Engineering*, October, 1936, p. 433.

34. Zink, F. J. The moisture content at which alfalfa leaves shatter. *Agricultural Engineering*, August, 1936, p. 329.

35. Roberts, E. J. Grass drying. H.M. Stationery Office.

36. Dixey, R. N., and Askew, R. P. Grass drying : a study of production costs. Agricultural Economics Research Institute, Oxford.

37. NEWMAN, J. E. Grass drying. *Jour. Society of Engineers*, 1937, Vol. XXVIII, No. 2, p. 65.

38. MERVINE, E. M., and McBIRNEY, S. W. New developments in sugar-beet machinery. *Agricultural Engineering*, November, 1936, p. 467.

39. SADIN, G., and ORDYNSKY, M. New machines in vegetable cultivation. *Mechanization of Socialist Agriculture*, No. 12, p. 35, Moscow, 1936.

40. L'électricité nous apporte-t-elle la solution de la culture mécanique des betteraves. *Le Génie Rural*, May, 1937, p. 14.

41. DAVIES, C., and SMYTH-HOMEWOOD, G. R. B. Investigations on machinery used in spraying. *Jour. South-Eastern Agric. College*, January, 1937, p. 61, and July, 1937, p. 50.

42. KABLE, G. W. The present status of electric fencing. *Agricultural Engineering*, November, 1936, p. 471.

43. BROWN, C. A. CAMERON. Note on electrical shocks. *Abstracts of Current Literature and Notes*, April, 1937, p. 11. (Institute for Research in Agricultural Engineering, University of Oxford.)

44. LÜBEN, DR. Elektrizität zur Schädlingsbekämpfung. *Die Technik in der Landwirtshaft*, February, 1937, p. 34; March, 1937, p. 58; April, 1937, p. 79.

FARM ECONOMICS.

IN introducing this annual summary of work in farm economics last year, it was remarked that to-day the farmer is confronted with an entirely new set of economic problems. He had long recognized that in a country predominantly industrial and tacitly committed to the policy of *laissez faire*, his farming would be controlled by prices fixed for him, in the main, by his competitors overseas; but in pre-War days England was not the only market open to the latter, and the home producer had found a way of life adapted to these conditions. All this was changed by the abnormal post-War state of world trade, culminating in the economic crisis of 1931, which made our country a dumping ground for the surplus products of the world. The Government was willing to help, but needed guidance, and at once farmers found themselves called upon to look far beyond the confines of their farms, and to assist, for the first time in living memory, in the formulation of a national policy designed to protect rural industry from the full force of world competition, without resort to measures which would prejudice the industrial recovery, of which the country stood also in such great need.

Another year has passed during which this question of national agricultural policy has received constant consideration, and further progress has been made. If some of the issues have thereby been clarified, however, a new complication has been added. There is the menace of war; and the question of how to

increase the production of food at home, should such a crisis once more arise, can no longer be excluded from any consideration of national agricultural policy.

I. Agricultural Policy.

1. *Agriculture and Industry.*

The position of agriculture in an industrial state was considered in 1936 by a Committee of the Association of British Chambers of Commerce, under the chairmanship of Sir Alan Garrett Anderson. The Report of the Committee is comprised in three short pages, but as a statement of the case for fostering home agriculture at the present time, its value is out of all proportion to its length. It is pointed out that Great Britain, by her policy of opening up agricultural areas overseas and enabling her debtors in these regions to pay in goods and services, has been able to sell her manufactures abroad while enabling her population to live better and more cheaply than ever before. In so doing, however, she has exposed her farmers and landowners to a competition which has reduced her cultivated land by 2,000,000 acres and the number of men employed on the land by half a million. By permitting the nation to buy world food at prices below cost, the Government secures to British industry a large financial gain, and the Report maintains that some of it "can and should be used to prevent the unnatural cheapness of food from causing distress to our agriculture." The importance of the home market for British industry is stated, and it is pointed out that the health of the nation in peace and its security in war require the maintenance of a vigorous rural industry.

This recognition by a group of industrialists of the place of home agriculture in national life is both timely and significant (Ref. 1).

2. *The Planning of Agriculture.*

(*a*) *Great Britain.* Any recognition of the need for a more prosperous farming community raises at once the problem of planning. It might be thought that this could be left to the industry itself upon the assumption that, given fair prices, farmers will use their land to the best advantage, without any direction from the State. The issues to-day, however, are too big to be left to chance, and if the country is to pay for the maintenance of agriculture the suggestion is that it should apply assistance deliberately with the intention of securing the production of those commodities which will be of greatest value to the nation.

Discussions during the past year of the planning of agriculture have centred round the problems of nutrition and of the maintenance of the food supply in time of war. National nutrition formed the subject of a group of papers read and discussed at the

meeting of the British Association. The Advisory Committee on Nutrition of the Ministry of Health has also presented its first report, and its findings should be of no little interest to farmers. Deficiencies in diet, it points out, are more commonly in the "protective foods," rich in vitamins, rather than in energy-giving foods rich in calories, which confirms previous investigators in their advocacy of more fresh food. But the energy-giving foods differ widely in their protective power, and the Committee recommends an extended use of the potato to replace some of the sugar and highly milled cereals. Attention is drawn, also, to the high nutritive value of skimmed and separated milk, the large wastage of which it deplores. A further volume from the League of Nations summarizes the standards of nutrition in various countries (Refs. 2, 3 and 4).

The question of agricultural planning and national defence is understood to be under consideration, but the matter did not reach the point of definite proposals in 1936.

(*b*) *New Zealand.* From New Zealand come two reports on recent agricultural organization. The first of them is an omnibus volume extending to over 800 pages, covering the whole field of land utilization, farm organization, finance and marketing. To summarize a work of this character here is clearly impossible. It may be recommended to those interested in tracing the recent development of New Zealand, whose farmers have become increasingly serious competitors in the home market for dairy products (Ref. 5).

The other publication deals specifically with economic changes in New Zealand during the last six years, and as agriculture is almost the only industry of the country, this means the steps taken by the Dominion Government to meet the depression. According to the Minister of Finance and Marketing, who contributes a preface, these have been of such magnitude that the very psychological outlook of the people has changed. What the situation was which farmers and the Government of the country had to face is well illustrated in the following table, showing the decline in the price of New Zealand butter on the London market, using January in each year since 1929 as the index.

Year.	Shillings per cwt.
1929	183
1930	153
1931	114
1932	97
1933	81
1934	66

New Zealand farmers reacted to the price fall by producing more butter in the hope of maintaining their incomes. Between

1929 and 1936 production rose 65 per cent., but notwithstanding this increase the total value of the product fell from about £16,000,000 to about £12,000,000. Unlike the Danes, the New Zealand farmers had not combined their production of butter with that of pork and bacon, as by-products, prior to the depression. As this continued, however, they were impelled to make better use of their separated milk and whey; the pig population rose nearly 75 per cent. between 1931 and 1935, while exports of pork (all of it to England) increased by 300 per cent. during the same period. Much of the increase in the output of British bacon factories under the Pigs and Bacon Marketing Boards is attributable, in fact, to these imports of frozen pork. The book brings home to readers the extraordinary intricacy of the problem created for the home Government by the necessity of balancing the claims of home producers against those of the Dominions (Ref. 6).

(*c*) *Germany*. A very different story is that of the evolution of German post-War agricultural policy. In the immediate post-War years, under the Government of the Social Democrats, the intention seems to have been to expropriate the landlords by taxation and to increase the number of small farmers, much as was done in some of the other Eastern European states. Following this, and before anything had been accomplished, there was a period during which the Government was dominated by urban middle-class interests, the agrarian representatives in the Reichstag being in a minority. German farmers found that they were being played off one against the other—by making the most of the internal conflict between the primary producers, the grain growers who wanted higher prices, and the secondary producers, the animal husbandmen, who wanted cheap feeding stuffs. In its last phase, under the National Socialist Government, group interests are being subordinated to one all-absorbing idea of national life. The philosophy of German farming differs fundamentally from our own; this well written and well documented study by an American student of economics is a clear and concise exposition of it (Ref. 7).

II.—Farm Management.

1. *Regional and Economic Surveys.*

(*a*) *East Anglia*. Last year reference was made to a survey of 220 farms in East Anglia by the Farm Economics Branch of the Cambridge University Department of Agriculture in the year 1933 and repeated in the year 1935, with the object of determining the changes and adjustments which farmers might be making in their methods of conducting their businesses, in accordance with changing conditions and markets. The survey was again repeated in 1936.

The region covered by the survey was divided as before into eight districts based on soil types, and while the financial results from the region as a whole were better in 1936 than in 1935, it is interesting to note that only the farms on the chalk lands in South Cambridgeshire show any substantial increase in their profits. This was mainly accounted for by larger receipts from barley. In view of the impression in some quarters that dairy farming is no longer remunerative, it may be remarked that Dr. Carslaw found that an improvement of the financial returns on the grass farms of the South Essex clays was due mainly to milk. Wheat growers did not fare so well, but in some districts declines in wheat income were offset by better returns from live stock. The number of workers continued to decline, but with farm output well maintained, the output per worker continued to increase. Dr. Carslaw estimates that the volume of the output of the worker has gone up by no less than 25 per cent. since 1931. This indicates what can be done to reduce unit costs by labour-saving machinery and by attention to labour organization. The position would be more satisfactory still if there were the assurance that this additional efficiency, as measured by production, were absolute, and that it were not due in some measure to postponement of expenditure on labour overheads. The appearance of many farms suggests that considerable labour charges would have to be incurred on roads, fences, gates, hedges and ditches before they could be regarded as in fair tenantable repair.

The Fen District of the Eastern Counties is not included in this survey. This area, by far the largest, richest and most important farming district in the British Isles, seems never to have been the subject of economic study (Ref. 8).

From the same advisory centre comes a Farmers' Bulletin, which summarizes the results of these and of the earlier economic surveys in the Eastern Counties in a form intended to bring the main conclusions to the notice of farmers, who, its authors suggest, are rarely interested in the fuller and more academic reports which have been published. For example, the bulletin points out that many farmers have increased the value of the output per £ of wages either by increasing the intensity of their farming by the use of more fertilizers or feeding-stuffs, without increasing the labour bill proportionately, or by reducing the labour bill without reducing the farm output proportionately. They point out that intensification of production is generally the better of the two alternatives, because the overhead costs of the farm, such as rent and the expenses of management, are fixed charges and the burden of them is reduced by spreading it over a larger output. Again, they draw attention to the influence of tractors on the financial results of farming, while, speaking more generally, they show the importance of studying farm management in detail with

a view to its improvement. It is not sufficient that the general return should be adequate. The number of pigs reared per sow, for example, should be watched ; the weight of pork per cwt. of food consumed ; the milk yield per cow and, again, the production per cwt. of food. The writers' advice, broadly speaking, is that higher farming and better profits go hand in hand. But the bulletin is valuable chiefly because its whole purpose is to encourage the reader in habits of recording and questioning at every stage and in every department of farm management (Ref. 9).

(*b*) *Romney Marsh*. The Romney Marsh district, which comprises some 60,000 acres, is one of the most interesting, both historically and agriculturally, in England. Formed mainly by washings brought down by the rivers draining the Weald, its inclosure from the sea began before historical records. Its soil is one of the most fertile in the country, and while portions are under the plough, its great industry is the production of mutton and wool from a breed developed to withstand its own peculiar climate. It carries a denser sheep population than any other district. This dependence on one commodity has made its agriculture peculiarly sensitive to economic changes, while the continual grazing of its pastures without rest has made the problem of parasitic disease one of exceptional importance. Two papers have been published, dealing particularly with these matters, one by Alfred J. Burrows and the other by G. H. Garrad. Burrows quotes figures showing that wool prices have fluctuated since the War from 3*s*. a lb. in 1920 to 5½*d*. in 1931. His paper is largely historical and descriptive, while Garrad deals more with present day problems and the possibility of changes in traditional farming practice, both on the arable land and with flock management, to improve the Marsh farmers' economic position (Refs. 10 and 11).

(*c*) *The Midlands*. It is the marginal land in farming, of course, which is most severely hit by agricultural depression. If falling prices hit the farmer on good land hard, they may drive the farmer on marginal land out of business. In the heart of Nottinghamshire, the district known as Sherwood Forest is an example. For centuries it was hardly farmed at all, but it was inclosed and brought under cultivation fairly widely during the first half of last century, when the industrial population was growing and colonial agriculture was still undeveloped. The Department of Agricultural Economics of the Midland Agricultural College has surveyed the district, and concludes that there are hundreds of acres which cannot be expected to return a profit, and which must be sown " in a spirit of hope rather than of expectation," except in an unusual season. It is suggested that such land should be thrown out of cultivation by agreement between landlord and tenant, and that it should be farmed

and rented only as rough grazing. It would be better, the writer thinks, to charge higher rents for smaller areas of good land rather than to encourage the tenant to cultivate bad land under the temptation of a low average rent. The conditions on some of the sand lands are that portions of the farms are merely a drain on the profits of the other parts, which would be better without them, both for the landlord and for the tenant. It is an interesting point in estate management policy. For the rest, the conclusions are that these soils, sour and dry, must have lime and they must have humus. The latest announcement of Government assistance may help farmers to supply the former. Only profitable conditions in the live stock industry can supply the humus deficiency (Ref. 12).

(*d*) *Devon and Cornwall.* In this region, records of the financial results of farming have been kept for some years. To the fourth report, issued by the Economics Department of the Seale Hayne Agricultural College, 91 farmers, occupying 20,000 acres, contributed figures, and these have been considered in six groups classified by districts. Four of them would seem too small to give results of any value, the number of farms in each ranging from four to 11. For the two groups, Mid- and East Devon, and South Devon, the number of farms was larger and the analysis of the figures may have some value. It is interesting to note that the conclusions confirm those of the Cambridge survey report, namely, that the farms with the highest gross output were the most profitable. It appears also that the returns from the smaller farms are higher, relatively, than those from the larger ones (Ref. 13).

(*e*) *Wales.* On lines somewhat similar to those of the Eastern Counties survey, is an investigation of the financial results of different types of farms in Wales, covering the years 1929–30 to 1933–34. It was a difficult period for farmers, and on farms of all types the story is one of dwindling profit, culminating in actual losses in the last three years, except on those selling milk. On them the situation was never so bad, and the year 1933–34 showed a marked recovery (Ref. 14).

(*f*) *Northern Province.* A valuable survey of the agriculture of Durham, Northumberland, Cumberland and Westmorland has been made by Professor J. A. Hanley and his colleagues in the Department of Agriculture at the Armstrong College. In their report they divide the area into farming units as the basis for further investigation. In the meantime the authors have prepared a first-rate description of the topography, soils and farming practice of the locality which might well serve as a model for the rest of the country. With similar information available, and revised periodically in conjunction with the collection of data for research work in the economics of the

various farming types, much valuable information would be available both for advisory work in farm management and for the direction of national policy. The authors were indebted to the Rt. Hon. D. Lloyd George for the costs of the survey (Ref. 15).

(*g*) *Scotland.* From Scotland come three reports on the profitableness of farming. The Department of Agriculture issued its Seventh Report, covering the year 1934–35. It is based on an analysis of the financial accounts of 245 farms, the largest number handled so far. Eighteen type-groups are distinguished. Full statistics of capitalization, income and expenditure of each are given, and a marked improvement in the results of the year is recorded by contrast with those of the previous year. It is remarked that it is impossible to disentangle the various factors which led to this result, but the importance of the Government's agricultural policy and the improvement in demand following on the increase in industrial employment and improved purchasing power are mentioned as having the greatest influence (Ref. 16).

Two other reports give the results of farming fortune in the East of Scotland and on the Border in 1935–36. These may be tabulated as follows :—

District and Type.	No. of farms.	Average size.	Capital.	Purchases.	Sales.	Profit.	Remarks.
East of Scotland		acres	£	£	£	£	
Arable farms ...	17	322	2,683	5,022	5,578	816	Equivalent to 4 per cent. on capital and about £700 for management.
Semi-arable farms	19	368	2,921	3,976	4,226	304	Equivalent to 4 per cent. on capital and about £180 for management.
Border.							
Semi-arable sheep	20	504	4,207	4,278	4,741	389	Equivalent to 4 per cent. on capital and about £220 for management.
High-ground sheep	9	863	4,962	3,527	3,792	473	Equivalent to 4 per cent. on capital and about £275 for management.

It should be noted that the handsome surplus available for management in the East of Scotland arable farms group is the first considerable sum for seven years (Refs. 17 and 18).

2. *Crops.*

(*a*) *Sugar Beet.* Though showing a decline in acreage during the last few seasons, sugar beet is still a crop of great importance

to many farmers. Its cultivation is well understood, but continental growers have had experience of it so much longer that it was considered desirable to obtain information of the methods at present in use in the main beet-growing areas of Europe, with particular reference to mechanical appliances. Assisted by the Sugar Beet Research and Education Committee and with the approval of the Ministry of Agriculture, F. Rayns and S. J. Wright made an extended tour of the continental districts during the sowing season and again during the harvest season, in 1935. From their report, several points of interest to British growers emerge.

Beet growing farms are grouped more closely round the factories, most of them within a radius of fifteen miles. Cultivation is restricted to deep, free-working soils in good heart. Labour is plentiful and skilled, so that less attention has been paid to the application of machinery. Deep ploughing is regarded as essential, down to a foot or more, and where there is danger of bringing up the sub-soil shallower ploughs fitted with subsoiling tines are used. Great importance is attached to a fine, firm seed bed to secure quick and even germination, and it is the practice to complete the final preparation and the drilling on the same day. Spacing drills are now being used in Sweden to get a better spaced plant and to save seed, and the results are encouraging. On the whole, manuring is heavier than in England. Harvesting methods at home have been based on those in use abroad and are still much the same, with the difference that the problem of mechanical lifters and toppers is receiving more attention here. British beet growers will find much to interest them in this report (Ref. 19).

(*b*) *Grass drying*. The progress of farming is for the most part a steady evolution based upon the application of scientific research and mechanical invention to everyday farm practice. At intervals this progress is punctuated and speeded up by something more revolutionary. Recent examples are the introduction of sugar beet, the invention of the milking bail, the use of the combine-harvester and, latest of all, the new methods of grass drying. The superior feeding value of dried young grass is now common knowledge, and the technique of cutting, drying and handling it was developed very rapidly. During the year under review the whole problem was the subject of three separate investigations, one initiated by a Committee of the Agricultural Research Council, another by the Agricultural Economics Research Institute, Oxford, and the third by a member of the staff of Imperial Chemical Industries, Ltd. The results have been published, and while they leave no doubt that in grass, cut young and properly cured, farmers have a new feed of great value, they suggest also that a good deal remains to be done

before the process can be recommended without reserve for general adoption. It is hardly a question of costs, for the figures published by Roberts, and by Dixey and Askew, show that the product can be turned out at a reasonable price when allowance is made for inexperience. It is a question rather of control of grass land and of the mechanical efficiency of the drying equipment. In both these matters a good deal has still to be learnt. To secure the high protein content upon which the value of the food mainly depends, the grass must never be allowed to grow more than a few inches. The capacity of the driers, however, is limited, and growers experienced difficulty in making their driers keep pace with the growth. The protein content falls rapidly as growth advances, and to put long grass through the drier is only to make hay by an expensive process. On the mechanical side, efficiency is limited by the amount of water that one unit of fuel can evaporate. It is of the first importance, therefore, that heat should not be lost during the drying process, and the design of some of the machines on the market, which necessitate removing the grass from the oven and turning it in the open air at half-time, seems to call for improvement. Again, the process as carried on in some machines is a mixture of mechanized and manual handling. Adjustments which would eliminate manual work altogether should make for economy. It is probable that the high hopes which were entertained for grass drying a year ago have been somewhat dashed by farmers' experiences of it. But the value of the product properly prepared is undeniable, and there is reason to expect that further experiment, both in the design of equipment and in the management of grassland to feed it, may make the new process a practical proposition (Refs. 20, 21 and 22).

(*c*) *Labour organization and mechanization.* The spread of machinery and the increase in the unit output of labour which often accompanies it, are responsible, no doubt, for a good deal of the reduction in agricultural employment which is generally deplored. But mechanization brings other labour problems, particularly on those farms where specialization in the production of one or two commodities, generally corn, is the practice. During the season of autumn cultivation and sowing, labour is fully employed on field work, as H. Whitby has shown, and again for about three months from the middle of March, when spring cultivation of fallows and top dressing wheat is in progress. In the first of these periods 80 per cent. of the time was thus employed. From the end of November until March it was only 15 per cent. of the men's time, and from the middle of June until harvest only 29 per cent. On the mixed farm, winter work with live stock, root harvesting, and thrashing and delivering corn occupy the staff, while the summer slack period on the specialized corn-growing farm finds the mixed farmer busy

with sheep-shearing and hay harvest. There is no economy in growing corn cheaply if unproductive work must be found to occupy the men during a large part of the year. The problem is discussed in Whitby's paper (Ref. 23).

3. *Live Stock.*

(*a*) *Dairy farming.* The problem of the cost of milk production is an old one, but it is of particular importance to-day in two directions. In general, the fall in farmers' prices due to the depression of pool prices by the increasing quantity of milk sold for manufacture, together with the rise in prices of feeding-stuffs, has caused famers to reconsider the economy of their methods. In particular, the premiums now payable for milk conforming to certain higher standards of cleanliness make it necessary that farmers should be able to compare this gain with the additional cost which is entailed.

On the question of general economy in milk production, a good deal of work is in progress. From Manchester come two reports emphasizing the importance of grassland management in milk costs. Grass, they point out, is the cheapest food, and methods are indicated for increasing its production and reducing the farmer's dependence upon purchased foods (Refs. 24 and 25).

The Farm Economics Branches both of Bristol and of Leeds have issued Farmers' Bulletins on the cost of feeding, the former for winter milk production and the latter for summer milk (Refs. 26 and 27). The Bristol centre has also issued a report on the financial results of milk production on about 120 farms in the Bristol province, being work undertaken at the request and at the cost of the Milk Marketing Board. It may be remarked that similar work was organized at the same time in the other advisory provinces, while arrangements were made for the preparation of a national summary by the Agricultural Economics Research Institute. The results of the Bristol survey will be of interest to milk producers in the counties of Gloucester, Hereford, Somerset, Wiltshire and Worcester. Comment on the figures may be left until the appearance of the national report (Ref. 28).

The Farm Economics Branch of the Cambridge Department of Agriculture established a food recording scheme for dairy cows in the spring of 1934, the membership of which is now about 90. A bulletin issued during the year gives the results of the work. As might be expected, many factors contribute to the production of cheap milk. Attention is drawn to the influence of milk yield, for the cost per cow may be low, but the cost per gallon high if yields are low. The cheapness of grass as a food is emphasized, and the need for spending money on grassland improvement. The practice of some farmers to use badly balanced rations, and of "a surprisingly large proportion" of them who still

judge the merits of a feeding-stuff by its price per ton instead of on its cost per unit of feed value, make for high costs, as does buying from hand-to-mouth instead of contracting forward for the biggest possible lots. But it is held that more important than all this is the control of the amount of food consumed by individual cows and by the herd as a whole. Many farmers, it is stated, have no idea of the amount of food given, and it was not uncommon to find, when records were kept, that farmers who believed they were feeding 4 lb. per gallon were in point of fact feeding 5 lb. (Ref. 29).

It is an interesting commentary on the difficulties of milk production and distribution that a majority of opinion amongst public health authorities seems to favour the compulsory pasteurization of milk for liquid consumption. At the same time, the desirability of organizing a supply of clean milk free from the tuberculosis bacillus is recognized. Pros and cons of a pasteurized supply and of a supply obtained safe from the cow and sold without further treatment have been stated in a publication by R. N. Dixey. The production of natural milk, clean and germ-free, is largely a question of cost. There is the improvement of cowsheds and dairies, the provision of extra equipment, and, above all, the cost of the elimination and replacement of cows reacting to the tuberculin test. All these questions were the subject of an investigation made on farms on which the change had been made from the production of ordinary milk to that of graded milk. The survey included 69 licensed for Certified milk, 50 for Grade A (T.T.) bottled, and 61 for Grade A (T.T.) in bulk, making 180 in all, distributed over 26 counties. Full information is given in the report of the costs of each of the essential changes on the respective farms, and the conclusion is reached that £13 a cow is a fair average figure for the total capital cost of cleaning up a typical farm. The report concludes with a record of farmers' own experiences and opinions, and a calculation of what the cost might be of organizing a safe supply of natural milk for the country as a whole (Ref. 30).

Although a little outside the definition of research work, perhaps, the attention of farmers may properly be directed here to a pamphlet by W. T. Price on methods of milk production. The author is the Agricultural Organizer for Wiltshire, in many parts of which county large-scale milk production, both in the traditional way and by the bail, is an important branch of farming. There is a great deal in his report which farmers in any county could assimilate with profit (Ref. 31).

(*b*) *Pigs*. A report on the financial problems of pig keeping comes from J. Wyllie, and it should be noted that the results are obtained from farmers keeping ordinary commercial stock on mixed farms, and not from specialized pig farms. Feeding-

stuffs accounted for 78 per cent. of the total costs. Perhaps the chief value of the report lies in the evidence that it affords of the need for more attention to record keeping. The farmer needs information about the average number of pigs reared per sow, the average cost of a weaner, and the food required to produce 1 lb. increase in live weight; until he is supplied with this it will be more by luck than judgment if his costs approach the minimum possible (Ref. 32).

The Bristol Advisory Province has also examined this question of pig production. In a report by C. V. Dawe and P. J. O. Trist, there is an account of the profit and loss on 16 pig farms, together with the results of an inquiry into the methods of feeding and housing. The need for record keeping is again emphasized, and the writers have made a special study of the influence of the boar. Every pig in the litters from each different boar was numbered and the name of the boar recorded. When the returns came from the factory the grades were allotted to each boar. Readers must refer to the report for the results, but it may be remarked that they by no means bore out the opinions which the farmer had formed of the respective merits of his sires (Ref. 33).

For some years past the College of Estate Management has granted a valuable scholarship yearly to enable the recipient to travel and to investigate some branch of agriculture abroad. An investigation thus undertaken covered the organization of pig production by members of co-operative societies in Denmark. Inspired by the success of butter manufacture, and dissatisfied with the prices paid by commercial bacon factories, Danish farmers started the first co-operative bacon factory in 1887, in the face of much opposition. The success of the movement needs no restatement here. Under the system of co-operation the pig stock of Denmark increased from about 527,000 at that time to more than 5,000,000 in 1931. Any decline since that date has been due to the operation of the British quota system. In his report on this development, G. R. H. Bishop summarizes as follows the advantages that have accrued to Danish pig producers :—

1. There is a greater incentive to produce good bacon pigs.
2. Carcases are dealt with in a more systematic manner, resulting in a more uniform product.
3. Payment is made on a weight-quality basis, and animals sold in the open market realize very little money.
4. The possession of a registered Trade Mark for Danish bacon.
5. The penalizing of individuals who farm in a way that is calculated to damage the prospects of the community as a whole.
6. The ability to combat trusts and prevent strikes.
7. A reduction in the expense of pig production, consequent upon the purchase of foods through co-operative schemes.

8. The provision of members with good stock boars.
9. The establishment of breeding centres.
10. The establishment of State and local pig testing stations, resulting in a phenomenal improvement in the pig, both quantitatively and qualitatively.

The author thinks that British farmers are temperamentally opposed to the adoption of the co-operative principle, which he regards as the ideal system, and he goes so far as to say that by "acting on purely selfish principles" the Pig and Bacon Boards "are strangling the industry that maintains them." His report is probably the best account of the great Danish pig industry available to the English reader (Ref. 34).

(*c*) *Beef*. Considering the importance of the beef industry and the long period of depression through which it has passed, it is surprising to note how little research has been done upon it recently. It was this that led to a small investigation, designed mainly to test methods, by J. H. Smith, of University College, Aberystwyth. Information was obtained from five farmers concerning 735 beef cattle. As stores, the average value was £12 15*s*. 4*d*., and as fat cattle they averaged £17 13*s*. 8*d*. without the subsidy. The numbers of bullocks and heifers were roughly equal, and it was noted that the bullocks showed the greatest increase in live weight. To the margin between the cost as stores and the realized value, which was £4 18*s*. 4*d*., must be added the beef subsidy, which came to £2 8*s*. 11*d*., giving the feeders a total average margin of £7 7*s*. 3*d*. The recorded net cost, of which full details are given, was £5, and the cost of marketing averaged 7*s*. 3*d*., giving a total cost of production and marketing of £5 7*s*. 3*d*., and leaving an average profit per animal fattened of £2. This was about 8*s*. 11*d*. less than the amount of the subsidy received. The figures relate to the year 1934–35 (Ref. 35).

(*d*) *Sheep*. A comprehensive survey of the sheep industry in Great Britain was undertaken by R. Owen Wood, with the assistance of a scholarship from the College of Estate Management. It is divided into three parts, the moorland and hill sheep, the arable breeds, and a general consideration of the economic structure of the sheep industry. The report is well illustrated with distribution and density maps, though it should be observed that the density maps are constructed by counties from the June 4th *Agricultural Returns*, and this method fails to localize the sheep population satisfactorily. In Kent, for example, where Romney Marsh has a greater density than any district in Britain, the effect of this method of representation is to spread it all over the orchard and hop districts of Mid-Kent, and the market-gardening of North Kent. A better representation might have been got by reference to the Agricultural Atlas of England and Wales (*Ordnance Survey Dept.*). Wood's report,

however, provides the agricultural student with a valuable account of the British sheep industry (Ref. 36).

(*e*) *Poultry*. It is common report that poultry keepers have been suffering severely in recent times. Prices of eggs and table poultry have been fairly maintained, but the cost of feeding-stuffs has doubled, and the incidence of disease, anyhow where intensive methods are pursued, has been serious. It is difficult to generalize about the poultry industry, however, for it is practised by very different methods. Egg production is still largely an adjunct of mixed farming, and here the effect of rising feeding costs has been least felt, as home grown foods can be used. But the specialist producer, whether by intensive, semi-intensive or free-range methods, has to buy everything. There is little evidence available for those who would wish to study the poultry industry in all its branches, but reference may be made to a report by J. D. Nutt, of the Department of Agriculture, Leeds, covering 26 Yorkshire farms. Food costs were found to range from 69 per cent. of total cost down to 31 per cent., while labour costs ranged between 40 per cent. and 9 per cent. The range for depreciation of both live and dead stock was equally wide. Methods of sale were as individualist as the costs of production, and the author wisely refrains from generalizations. It is clear, however, from his results, that the specialist enterprise needs more capital equipment and entails a higher level of costs, and he emphasizes the unsatisfactory and disorderly state of egg marketing as at present conducted (Ref. 37).

III.—Marketing, Prices and Supplies.

1. *Marketing*.

(*a*) *Milk*. The report of the Reorganization Commission for Milk was issued shortly before the close of the year. Its interest to milk producers lay mainly in two recommendations. The first of these was that the State should make a contribution to maintain the price of manufacturing milk above a minimum figure. The second was that a Permanent Milk Commission should be established to take over price-fixing. It will be remembered that the first Reorganization Commission had also recommended a Permanent Milk Commission, which was to consist of representatives of producers and distributors, with an independent chairman. The subsequent Milk Marketing Scheme as sanctioned by Parliament, however, provided for a Producers' Board with full powers to fix prices. Thus the new proposal goes even further than the original one, for it would take price-fixing entirely out of the hands of the industry. Subsequent events have shown that the Government is not prepared to go thus far, and in their proposals now before the country, control of prices is to remain in the hands of the Producers' Board.

Amongst other matters, the Reorganization Commission referred to distribution, expressing the view that here was a direction in which to look for savings in the cost of milk to the consumer, and they recommended that the subject should be investigated by the Permanent Milk Commission which they proposed (Ref. 38).

(*b*) *Australian Primary Products.* The problem of marketing concerns our Dominions as much as ourselves. It is often asserted that their difficulties are fewer because they are consigning to an overseas market through a "bottle-neck," which facilitates combination amongst producers for the study of market requirements. However this may be, the fall in world prices has hit primary producers in other countries as much as in our own. The problems as they affect Australian and New Zealand farmers have been studied by Dr. W. M. Smith, a New Zealand student who worked for some time under the Professor of Imperial Economic Relations in London University, and his researches have been embodied in a book in which the whole question of the part of the State in marketing control and the increase and stabilization of producers' returns are examined. While admitting the vulnerability of the primary producer, Dr. Smith is a frank critic of the attitude of Australian and New Zealand farmers towards State assistance. "The worst feature of the whole process of Government intervention," he says, "is undoubtedly that it opens a way for the unscrupulous exploitation of the crisis by many individuals and concerns who benefited by various forms of subsidy and remissions of debt to which they were not fairly entitled. Indeed, it is not too much to say that in Australia and New Zealand the evasion of their liabilities by a section of the rural interest has been almost erected into a system and that subsidies of one sort or another have come to be regarded as the inalienable prerogative of agriculture." The book will be of interest and value to those who look to the experience of other countries for guidance in our own difficulties, but it is also a permanent contribution to the history of market organization (Ref. 39).

2. *Prices and Supplies.*

(*a*) *The Food Council.* The reconstituted Food Council has presented a report to the President of the Board of Trade for 1936. The powers of this body are very limited and in effect it can do little more than any academic institution. Within its limitations, however, its work is done with thoroughness and a full sense of responsibility, and farmers, while they may disagree with some of its conclusions, might do well to consider them. The Council draws attention to the importance of an early agreement between pig producers and bacon curers, if the

advantages of the regulation of bacon imports are not to be lost. It reminds us that under the provisions of the Agricultural Marketing Act, 1933, regulation of the import of any product is permitted only if a marketing scheme is in operation or in preparation. Milk producers, again, may be interested, though probably as critics, in the view expressed by the Council on the boycott of bakers selling bread below agreed prices by withholding supplies of flour from them. Price cutting by producer-retailers was stopped by the Milk Marketing Board, but the recent report of the Milk Reorganization Commission recommended that fixed minimum prices should be abolished. It is a nice point to determine how to protect the producer from unfair competition while avoiding the unfair exploitation of the consumer (Ref. 40).

(*b*) *World Production and Trade.* Students of production and trade in agricultural commodities will welcome a series of publications compiled by the Intelligence Branch of the Imperial Economic Committee. Full information is provided on the relative importance of the countries of origin of foods, the markets to which they consign and the great changes that have occurred in both during recent years. How many people, for example, are aware that the export of frozen pork from New Zealand rose from 169,000 cwt. in 1929 to 492,000 cwt. in 1935? Further, that the whole of this increase has been marketed in Britain and that it accounts for a great part in the increase in the output of home-cured bacon of recent years? (Refs. 41 and 42).

(*c*) *Milk consumption.* An investigation of the consumption of milk and milk products in the City of Oxford was made during the year by Dr. K. A. H. Murray. To secure a fair sample, every thirtieth dwelling house was visited, from each of which particulars were collected of purchases of milk and its utilization in the household, as well as of purchases of all milk products. Information as to the size of the household, the family income and the total expenditure on food was also collected, and the data was then classified by income groups, which were in their turn sub-divided according to the numbers in the family and the ages of the children. The results confirmed previous investigations of the quantity of milk consumption, which had shown that the amount rose as the family income rose. But it also emerged from the Oxford survey that families with equal incomes, with equal numbers of young children and with a total expenditure on food approximately the same, showed considerable variations in the amount spent on milk. Thus, in families of two adults with four children under 14, living at the same income level, the purchases of liquid milk might vary so much as 100 per cent. Murray's conclusion is that while the controlling influence of

price on the quantity of milk consumed is demonstrated once more by the Oxford evidence, the importance also of the factors of individual taste, and even of prejudice, has also to be reckoned with (Ref. 43).

(*d*) *Egg Prices.* As stated already, egg producers had a rough passage in 1936, and there have been insistent demands for further restriction of egg imports, or for the imposition of new duties. An analysis of the price position by O. J. Beilby shows that the situation is not so simple as these demands would imply. There is much difference in the quality of eggs, and effective competition with the home-produced article comes only from Irish and Danish imports. Beilby's analysis shows that general control of imports sufficient to bring about an effective rise in home prices would seriously reduce the demand for eggs. Restriction of consumption must surely be the worst of all ways by which to increase prices (Ref. 44).

IV.—Miscellaneous.

1. *The Farm Worker.*

Few things are causing the farmer more concern at the present time than the labour situation. No doubt a good deal of the decline in employment registered in the *Agricultural Statistics*, year by year, is due to the increasing use of machinery and the consequent rise in the output per unit of labour. But this is not the only explanation, and there is no doubt that the younger farm workers in particular are taking every opportunity of getting into industrial employment, where they have more social life and where, above all, their time is their own from Saturday midday until Monday morning. Farmers in the neighbourhood of some of the new factories erected outside the recognized industrial areas, and those who occupy lands near the new aerodromes, are finding the greatest difficulty in maintaining their labour staffs, while everywhere there is the complaint that skilled workers cannot be replaced. A paper read by W. R. Seward to the *Farmers' Club* deals with the need for more organized technical instruction for the farm worker. In the days when boys went on to the farm on leaving school and stayed there, there were opportunities, both by observation and practice, for acquiring a proficiency in the skilled arts of the husbandman. To-day, these opportunities are lacking, in a large measure, and technical instruction, both by classes at the farm institutes, and by arrangements with the older workers on the farm, must deliberately be organized if the supply of skilled workers is to be maintained. Possibly, too, the recognition of skill by the payment of higher wages must be considered (Ref. 45).

2. *Agricultural Wages in Scotland.*

Under the Corn Production Act, 1917, an Agricultural Wages Board for Scotland was set up, but the Agricultural Wages (Regulation) Act, 1924, which reconstituted the Agricultural Wages Board for England, after the dissolution of both Boards by the Corn Production Act (Repeal) Act, 1921, did not apply to Scotland. In January, 1936, the Secretary of State for Scotland appointed a Committee to examine the conditions of employment and wages of farm workers in Scotland and the changes that had taken place in recent years, and to report whether any regulation of remuneration or of conditions of employment was called for.

In its Report, the Committee says that from 1917 onwards wage agreements were made by collective bargaining between the National Farmers' Union of Scotland and the Scottish Farm Servants' Union, which applied throughout most of Scotland. The effect was that the Scottish Agricultural Wages Board was otiose, and the Scottish Farm Servants' Union did not seek its re-establishment in Scotland when the English Board was reconstituted in 1924. From that date, however, conditions deteriorated rapidly, until the system of voluntary collective agreements collapsed altogether and workers had to rely upon their own individual powers of bargaining. Since 1930 the housing shortage and the surplus of labour had rendered it difficult for them to offer effective resistance to the series of wage reductions which have taken place, whereas the English farm workers derived some protection from the existence of statutory wage regulation. The Committee recommended, accordingly, that the application of the Agricultural Wages (Regulation) Act, 1924, should be extended to Scotland, with certain modifications (Ref. 46).

3. *Land Utilization.*

Six years ago, the Land Utilization Survey of Britain was begun by the London School of Economics under the direction of L. Dudley Stamp. The method of the survey is familiar to most people, and an assessment of its results can now be made through the maps and county reports which have been issued. It was inevitable, presumably, that a county basis should have been adopted for the final presentation of the survey. This geographical and administrative unit is so firmly established that it is difficult to avoid it even for purposes to which it has no application, and the use of the land, surely, is one of these.

A report on the county of Berkshire was published during the year, and it gives a complete account of land utilization and its distribution, related to the geology, the soil types, the topography and the climate. Particularly on the west, all of these merge

insensibly into the next counties, so that much that is said here will have to be repeated when they come up for report in their turn. That the conditions of usage are always changing is fully recognized, and the authors refer, for example, to the spread of aerodromes and the consequent withdrawal of land from cultivation. They are also alive to minor inaccuracies in their work, arising, for example, from the difficulty of distinguishing between permanent and temporary grassland. But nothing like it has been attempted since the reports drawn up about 140 years ago for the Board of Agriculture and Internal Improvement, and the present series go far beyond those in the wealth of information that they supply (Ref. 47).

4. *The Agricultural Register.*

Readers may be reminded again of this annual publication by the Agricultural Economics Research Institute, Oxford, which is a book of reference containing full information about agricultural legislation, agricultural organization under the Marketing Schemes, and changes in the regulation of imports for Great Britain. Statistics of prices and supplies of agricultural products and requisites are also included, and there are sections on the changes in agricultural wages and other matters (Ref. 48).

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References.

Agricultural Policy.

1. Association of British Chambers of Commerce. Report of the Committee on Agriculture and Industry, March, 1937.
2. National nutrition and British agriculture: four papers read before the British Association at Blackpool, September, 1936.
    1. Orr, Sir J. B. Agriculture and public health.
    2. Hall, Sir A. D. A national plan for agriculture.
    3. Watson, J. A. Scott. Increased meat production.
    4. Kay, H. D. Increased production of milk.

    Scottish Jour. of Agric. Vol. XX, No. 1, January, 1937.
3. Ministry of Health. Advisory Committee on Nutrition. First Report (London: H.M. Stationery Office, 1937.)
4. League of Nations. The problem of nutrition. Vol. 3. Nutrition in various countries. (Geneva, 1936.)
5. Belshaw, H., and Others. Agricultural organization in New Zealand. (Melbourne: New Zealand Institute of Pacific Relations, 1936.)
6. Sutch, W. B. Recent economic changes in New Zealand. (Institute of Pacific Relations: New Zealand Council, 1936.)
7. Holt, J. B. German agricultural policy, 1918–1934. (Chapel Hill: University of North Carolina Press, 1936.)

Farm Management.

8. Carslaw, R. McG. Changes in the economic organization of agriculture: a comparative study of conditions in the Eastern Counties of England in 1935 and 1936. Cambridge University: Department of Agriculture: Farm Economics Branch, *Report* No. 24, May, 1937.
9. Farm adjustments raise profits. Cambridge University: Department of Agriculture: Farm Economics Branch, *Farmers' Bulletin*, No. 6, June, 1937.

10. Burrows, Alfred J. Romney Marsh. *Jour. of the Chartered Surveyors' Institution.* Vol. XVII, Pt. I, July, 1937.
11. Garrad, G. H. The Romney Marsh problem. Kent Education Committee. May, 1936.
12. Makings, S. M. Farming forest sand: sand land farming in the Sherwood Forest area of Nottinghamshire; its history, its present condition, its defects and its difficulties. Midland Agricultural College: Department of Agricultural Economics, July, 1936.
13. Henderson, R. Financial results on certain Devon and Cornish farms for the year 1934–35. Seale Hayne Agricultural College, Newton Abbott. Department of Economics, *Farmers' Report* No. 12.
14. Howell, J. Pryse. The financial results of different types of farms in Wales. *Welsh Jour. of Agric.* Vol. XII, 1936.
15. Hanley, J. A., Boyd, A. L., and Williamson, W. An agricultural survey of the Northern Province: the counties of Durham, Northumberland, Cumberland, Westmorland. Newcastle-upon-Tyne: Armstrong College: Department of Agriculture, 1936.
16. Seventh report on the profitableness of farming in Scotland, 1934–35. Department of Agriculture for Scotland, 1936.
17. Report on the financial results of: (1) 17 East of Scotland arable farms, and (2) 19 East of Scotland semi-arable farms for 1935–36. Edinburgh and East of Scotland College of Agriculture, June, 1937.
18. Report on the financial results of: (1) 20 Border semi-arable sheep farms, and (2) 9 Border high-ground sheep farms for 1935–36. Edinburgh and East of Scotland College of Agriculture, May, 1937.
19. Rayns, F., and Wright, S. J. The cultivation and harvesting of sugar-beet on the Continent. Ministry of Agriculture and Fisheries: Bulletin No. 102. (London: H.M. Stationery Office, 1936.)
20. Roberts, E. J. Grass drying: a report prepared for the Committee on the Preservation of Grass and Other Fodder Crops. Agricultural Research Council: Report Series No. 2. (London: H.M. Stationery Office, 1937.)
21. Dixey, R. N., and Askew, R. P. Grass-drying: a study of production costs in 1936. (Oxford: Agricultural Economics Research Institute, 1937.)
22. Cheveley, S. W. Grass drying. (London: Ivor, Nicholson & Watson, 1937.)
23. Whitby, H. Labour requirements on a mechanized wheat farm. *Scottish Jour. of Agric.* Vol. XIX, No. 4, October, 1936.
24. Management for milk production: research in cost of feeding, 1935–36. Manchester University: Agricultural Economics *Report* No. 4, 1936.
25. Stewart, J., and Stewart, A. H. Management for milk production: summer feeding. Manchester University: Agricultural Economics Report No. 5, 1937.
26. A note on feeding and summer milk production. Leeds University: Department of Agriculture: Economics Section, *Farmers' Report* No. 12, June, 1937.
27. Dawe, C. V., and Blundell, J. E. Winter feeding for milk production (an economic study). Bristol University: Department of Agriculture and Horticulture, Bulletin No. 16, 1936.
28. Dawe, C. V., and Blundell, J. E. The financial aspect of milk production. Bristol University: Department of Agriculture and Horticulture, Bulletin No. 15, 1936.
29. Management in milk production. Cambridge University: Department of Agriculture: Farm Economics Branch, *Farmers' Bulletin* No. 5, July, 1936.

30. Dixey, R. N. Tuberculin-tested milk: a study of re-organization for its production. (Oxford: Agricultural Economics Research Institute, 1937.)
31. Advisory report on milk production. Wilts. County Council: Agricultural Education Sub-Committee, March, 1937.
32. Wyllie, J. Financial problems in pig keeping. South-Eastern Agricultural College, Wye, Kent. Department of Economics, Report No. XXIII, 1936.
33. Dawe, C. V., and Trist, P. J. O. A survey of pig management. Bristol University: Department of Agriculture and Horticulture, Bulletin No. 17, 1937.
34. Bishop, G. R. H. The improvement of bacon pigs by co-operative methods. College of Estate Management: Reports of the College Travelling Scholars in Agriculture, No. 4, 1937.
35. Smith, J. H. Costs of fattening cattle. *Welsh Journal of Agriculture*, Vol. XII, 1936.
36. Wood, R. Owen. A survey of sheep management in Great Britain. College of Estate Management: Reports of the College Travelling Scholars in Agriculture, No. 3, 1937.
37. Nutt, J. D. Some economic aspects of poultry keeping in Yorkshire: a study of 26 farms for the year ending September 30, 1936. Leeds University: Department of Agriculture. Economics Section: *Farmers' Report* No. 10, March, 1937.

MARKETING, PRICES AND SUPPLIES.

38. Milk: Report of the Reorganization Commission for Great Britain. Ministry of Agriculture and Fisheries: Economic Series, No. 44. (London: H.M. Stationery Office, November, 1936.)
39. Smith, W. Millar. The marketing of Australian and New Zealand primary products. (London: Pitman, 1936.)
40. Report by the Food Council to the President of the Board of Trade for the year 1936. (London: H.M. Stationery Office, 1937.)
41. Dairy produce: a summary of figures of production and trade relating to butter, cheese, preserved milk, eggs, egg products, compiled in the Intelligence Branch of the Imperial Economic Committee. (London: H.M. Stationery Office, 1936.)
42. Meat: a summary of figures of production and trade relating to beef, mutton and lamb, bacon and hams, pork, cattle, sheep, pigs, canned meat. Imperial Economic Committee. (London: H.M. Stationery Office, 1936.)
43. Murray, Keith A. H. Milk consumption. (Oxford: Agricultural Economics Research Institute, 1937.)
44. Beilby, O. J. Egg prices: a study of the factors affecting prices and production. (Oxford: Agricultural Economics Research Institute, 1937.)

MISCELLANEOUS.

45. Seward, W. R. Technical instruction and the agricultural worker. *Jour. of the Farmers' Club*: April, 1937.
46. Report of the Committee on Farm Workers in Scotland, 1936. (Edinburgh: H.M. Stationery Office, 1936. Cmd. 5217.)
47. The Land of Britain. The Report of the Land Utilization Survey of Britain. Stamp, L. Dudley, ed. Part 78: Berkshire. J. Stephenson, with an historical section by W. G. East. (London: School of Economics, 1936.)
48. The Agricultural Register, 1936–37. (Oxford: Agricultural Economics Research Institute, 1937.)

DAIRY FARMING AND DAIRY WORK.

I.—General Notes.

Supplies and Consumption of Dairy Produce.

The first section of this annual review is usually devoted to subjects of general interest to the dairy farmer. Last year special attention was given to a number of important reports which had been issued on the general question of nutrition and public health, and on the parts which British agriculture, and particularly British dairy farming, might play in supplying a sufficiency of milk—the food which alone "contains all the materials essential for growth and maintenance of life in a form ready for utilization by the body." Reference was made to the need for time to accumulate accurate knowledge on nutritional questions and to prepare acceptable plans and schemes. During the past year work of this nature has been proceeding steadily, and several reports on different aspects of the question are available for review.

Some interesting information regarding the consumption of milk and dairy produce in different countries is given in a report issued by the League of Nations (Ref. 1). The consumption per head per annum of milk (including condensed and evaporated milk), butter and cheese, and of all these foods in terms of milk equivalent, has been carefully estimated for a number of countries for the five-year periods 1925–29 and 1930–34. With few exceptions increases are shown in the second period, and the greatest are found in Denmark and in Great Britain.

ESTIMATED CONSUMPTION PER HEAD PER ANNUM OF MILK, BUTTER AND CHEESE.

Country.	Milk.		Butter.		Cheese.		Liquid Milk Equivalent.	
	1925–29	1930–34	1925–29	1930–34	1925–29	1930–34	1925–29	1930–34
	gall.	gall.	lb.	lb.	lb.	lb.	gall.	gall.
Belgium .	16	17	17	21	6	6	68	80
Denmark .	25	36	13	18	11	12	68	92
France . .	21	23	10	13	11	12	58	69
Germany .	26	23	14	16	11	13	74	79
Italy . .	5	7	2	2	10	11	21	23
Holland .	—	30	12	16	12	14	—	80
Switzerland .	59	58	12	14	22	19	111	112
Great Britain .	22[1]	23[1]	16	22	8	9	73	89
United States .	37	39	18	18	5	4	81	81
Australia .	22	22	30	29	5	4	102	102
New Zealand .	28	28	33	38	5	8	115	127

[1] Figures for 1924–25 and 1930–31 respectively.

When the total consumption of these dairy products is stated in terms of liquid milk equivalent, Great Britain compares not so unfavourably with some of the other countries which are held up to us as examples. It is true that we drink comparatively little milk in liquid form, but we consume more butter than any other European country. Such comparisons, however, should not give us a false sense of security, and we must remember that the report on *Food, Health and Income*, briefly summarized in last year's review, showed that an increase of 16 per cent. in the consumption of milk and of 15 per cent. in that of butter was required to bring the diet of the poorer groups of the population up to a level adequate for full health.

At the meeting of the British Association at Blackpool, four papers were read before Section M (Agriculture) dealing with National Nutrition and British Agriculture. Sir John Orr spoke on Agriculture and Public Health (Ref. 2) and explained the need for the consumption by the poorer sections of the population of larger quantities of the "protective" foods—milk, dairy products, eggs, fruit and vegetables. He pointed out that the purchasing power of the poor does not permit them to buy sufficient quantities of these foods, that the farmer must get a remunerative price for his products to enable him to pay increased wages to agricultural labourers and to modernize his equipment, and that there is, therefore, an apparent conflict between the interest of the consumer and the interest of the producer. He emphasized that agriculture and public health must be looked at together, *i.e.*, as parts of one great food problem which can be solved only if the State is willing to embark upon a national food policy.

Sir Daniel Hall (Ref. 3) dealt with a national plan for agriculture, stressing the necessity of increased production from the

land, having in view the emergencies which would arise in the event of war and the specific demand for the production of those foods which are necessary to provide an improved dietary for the general population. He suggested that the essential foods might be cheapened by increased efficiency on the part of the producers, and by diminishing the difference between the prices the farmer gets and those the consumer pays. To attain the latter end he considered it essential that there should be a complete reorganization of the whole machinery of distribution and retail sale.

The problem of increased meat production was dealt with by Prof. Scott Watson (Ref. 4). He realized that the increase in the production of milk, required to provide sufficient for the ideal dietary, would mean many more cows and less land available for beef stock, but emphasized that a proportion of the extra milk could be obtained by increasing the milk yield per head and by lengthening the milking life of cows by the control or eradication of the chief diseases. He was also of the opinion that our meat supply could be maintained or increased (1) by finding room for some beef cattle and for sheep on the dairy farms on the better land, (2) by increasing the stock-carrying capacity of the mountain and moorland pastures, and (3) by increased production of pork, bacon, poultry and eggs.

Prof. H. D. Kay discussed the problems involved in producing the increased supplies of milk which would be necessary when the population as a whole bought, or were given, the ideal daily allowance of milk (Ref. 5). He pointed out that, at the present average milk yield of cows, the numbers would require to be nearly doubled; but he considered that it would be much more desirable and economical to increase the average yield and to lessen the wastage of cows by the control of disease. He was also of the opinion that by the greater use of scientific knowledge the extra milk might be obtained if the area of land devoted to milk production were increased by some 20 per cent.

The Milk Marketing Scheme.

The report of the Milk Marketing Board on the third year of operations of the Milk Marketing Scheme (Ref. 6) contains much interesting information on the production and utilization of milk and on the various activities of the Board. During the twelve months ended 31st March, 1937, the total quantity of milk passing through the Board was fully 1,011 million gallons, as compared with fully 991 million gallons in the previous year—an increase of 2 per cent. The quantity absorbed by the liquid milk market was fully 669 million gallons, while the balance of about 343 million gallons was used for the manufacture of produce. These amounts, stated in percentages, show 66·3 per cent. sold as

liquid milk and 33·7 per cent. for manufacture—exactly the same percentages as in the previous year. The demand for liquid milk, however, showed a slight increase amounting to some 12½ million gallons (or 1·9 per cent.) over that of the preceding year; this result is a welcome indication that the efforts of the Board to increase the consumption of liquid milk are being successful. Moreover, there is evidence that the actual increase in the demand for liquid milk is greater than is indicated by the above figures; the number of herds possessing licences to sell "Tuberculin Tested" milk, rose from 1,055 in March, 1936, to 1,670 in March, 1937, and a large proportion of the milk from these herds is sold in the liquid milk market outside the Scheme.

There has also been a steady increase in the number of herds possessing "Accredited" licences. In the previous year the Accredited herds had an output (for which the producers received an extra penny per gallon) of 175 million gallons, or 18 per cent. of the milk sold through the Board; whereas last year the amount was 311 million gallons, or 31 per cent. of the total. Another interesting feature was the increase in the quantity of milk made into cheese on the farm; in 1935–36 some 15 million gallons was used in this way, while in 1936–37 the amount was over 18 million gallons—an increase of 20 per cent. The quantity of milk consumed under the Milk-in-Schools Scheme showed a slight decrease during the year (Ref. 7).

The experience gained by the Board during 1934 and 1935 had shown the need for introducing improvements to some sections of the Milk Marketing Scheme, and in 1936 the Board put forward amendments (Ref. 8) affecting five main principles and a number of administrative matters. The chief amendments dealt with (1) the abolition of the existing exemption of wholesale producers having four cows or less, (2) amendment of the clauses dealing with depot transport charges and deductions, (3) reduction of the contributions by producer retailers, (4) simplication of election procedure and (5) increase in the number of registered producers necessary to demand a poll on the revocation of the Scheme. These amendments were voted on by the registered producers in July, 1936, and approved by a large majority.

Objections to several of the amendments were, nevertheless, formally lodged by a number of bodies, and a public inquiry, as provided for by the Marketing Act, 1931, was held in October and November, 1936. The Milk Board had also made representations to the Minister of Agriculture that the existing exemption from the Marketing Scheme, of "Tuberculin Tested" milk sold as such, should be withdrawn, and this subject was included amongst those considered at the public inquiry referred to. The decisions of the Minister of Agriculture on the report submitted to him by the Commissioner holding the public inquiry

were made public in July, 1937. The amendments asked for were agreed to with minor alterations. Further, the Ministers of Agriculture and Health agreed to the withdrawal of the exemption of "Tuberculin Tested" milk from the Marketing Scheme, under specified conditions.

In the last two issues of this review brief reference was made to the Milk Reorganization Commission, with Mr. A. E. Cutforth as Chairman, appointed in February, 1935, to consider and report on the organized marketing of milk in England and Wales and Scotland. This Commission (which may be shortly described as the "1936" or "Cutforth" Commission to distinguish it from the "1935" or "Grigg" Commission) issued its long-awaited report in November of last year, and attention was at once concentrated on certain recommendations which, if adopted, would radically change the status of the existing Milk Board. The report (Ref. 9) should be consulted for a detailed explanation of the reasons which led the Commission to their various conclusions, but it may be briefly stated that the main recommendations are the establishment of an independent and impartial Permanent Milk Commission as a central authority for the industry as a whole; this Commission would plan a production policy capable of meeting the nation's needs and implement its policy through the medium of prices; it would fix both producers' prices and buying prices and would be responsible for the co-ordination of the various interests concerned and for promoting the general progress and welfare of the industry. The Cutforth Commission realized that their main recommendations would involve the transference to the proposed Permanent Milk Commission of many of the powers at present held by the Milk Marketing Board (which represents the producers only) and that such recommendations would not be readily acceptable. In this connection the following quotation from the report is concise and apt :—

"We have full sympathy with the determination of milk producers to maintain a satisfactory economic position for themselves; but criticism of our recommendations based on the ground that they will involve the transfer of certain powers would leave out of account some of the most important aspects of a complicated problem. The Milk Marketing schemes appear to give very wide powers to producers, acting through their Boards; but there can be no doubt that public opinion would resent any disposition to use such powers unreasonably. If organized milk marketing is to remain and to develop, it is bound to be on a basis which ensures that due consideration shall be given to the needs of all parties to the sale and purchase of milk and that decisions on such matters as prices and contract terms, by whomsoever they may be made, shall be equitable. The necessity for ensuring to the consuming public an ample supply of clean, safe milk at a reasonable price must be the over-riding consideration. One essential condition for achieving this object is that producers shall be treated fairly, for otherwise the milk would not be produced. But the interest of individual sections must not be permitted to overrule the

general interest. . . . We should regard it as unfortunate if it should continue to appear that terms can be imposed by one section of an industry upon all other sections and upon the general public : for that could only serve to foster a spirit of antagonism and unrest. We feel sure that, from this point of view alone, producers have far more to gain than they can possibly lose by the establishment of the independent authority which we have recommended."

The recommendations of the Commission outlined above, and those on other subjects which cannot be dealt with here, have been debated at length in the agricultural press and elsewhere. The Milk Marketing Board have published their considered views in the *Home Farmer* for May (Ref. 10) and emphasize that the appointment of a Permanent Commission with the powers recommended would be a complete negation of the principles embodied in the Agricultural Marketing Acts.

Recently the Government have outlined the steps they propose to take in view of the above-mentioned and other reports (Ref. 11). This statement of policy and the proposals to carry it into effect, which will be laid before Parliament in due course, will be matters of supreme importance to the dairying industry during the ensuing year.

Milk in Schools.

Reference has already been made to the slight decrease in the quantity of milk consumed under the above Scheme ; in this connection attention may be drawn to the report, issued by the Hannah Dairy Research Institute, Scotland, on an "Inquiry into the Drinking Habits of Children of School Age, with Special Reference to Milk Drinking" (Ref. 12). The report points out that no attempt was made to ascertain the milk-drinking habits of children prior to the introduction of the Milk-in-Schools Scheme, so that no basis is available by which the ultimate success or failure of the Scheme could be judged. The inquiry covered fully 13,000 school children (two-thirds in Glasgow and one-third in districts in Ayrshire) and its main object was to study the milk-drinking habit, and not to determine the total consumption of milk. The outstanding fact revealed by the inquiry is the small extent to which milk is normally drunk by children of school age. Just over one half of the 13,000 children did not drink milk at all, and another 4,000 took it only once daily, excluding whatever might be taken at school under the Scheme. Among the poorer children some 60–80 per cent. in the different centres did not drink milk. On the other hand, only 5 per cent. of the children did not take tea at least once daily, while 50 per cent. took it three or more times daily. To obtain some measure of the children's preferences a list of five common beverages—milk, tea, coffee, cocoa and water—taken at meals was submitted and nearly 40 per cent. showed a preference for

milk. (A preliminary survey in Ayrshire had shown that mineral waters should be excluded from any such list). A large proportion of those who chose milk did not receive it at home. Over a period of eighteen months there was a definite decline in the number of children taking milk at school, and an attempt was made to counteract this tendency by providing flavoured milks in three schools. There was an immediate increase of 44 per cent., but after the first week the novelty apparently wore off, and the demand fell rapidly until, after five weeks, the demand was only 10 per cent. above the initial demand for plain milk. It is also noted that the decrease in demand for milk under the Scheme has taken place amongst those children who pay for their milk, the number receiving milk free showing a progressive increase. The results obtained in this inquiry show that the Scheme has practically doubled the frequency of milk drinking, apparently without reducing the consumption of milk in the home. This is a very satisfactory result, but the view is expressed that, if the Scheme is ultimately to achieve the degree of success originally hoped for, it will be necessary to provide free milk for all school children.

Tuberculin Tested Herds.

The increase in the number of herds licensed to produce "Tuberculin Tested" milk under the Milk (Special Designations) Order has already been mentioned. This increase shows a growing interest on the part of dairy farmers in the eradication of tuberculosis, and there is no doubt that this interest has been stimulated by the financial advantages which accrue from the exemption of this milk from the Milk Marketing Scheme. One of the problems of the immediate future is whether the inclusion of this grade of milk—the highest grade recognized in this country—in the milk Scheme can be accomplished under conditions which will continue to provide sufficient inducement to farmers to comply with the conditions under which licences are granted. Reliable information on the extra costs involved in the regular day-to-day compliance with these conditions has not been published recently, but Dixey, of the Agricultural Economics Research Institute, has collected valuable information on the extra capital costs of "cleaning up" herds, buildings and equipment to attain the required standard (Ref. 13). The extra capital costs have been obtained from a survey of 180 farms whose occupiers held licences under the Milk (Special Designations) Order, 1923; of these, 69 were for the sale of Certified Milk, 50 for the sale of Grade A (T.T.) milk bottled on the farm, and 61 for sale by wholesale in bulk. The farms were distributed over 26 counties, mainly in the south and west of England, and each farmer supplied records of the capital expenses which he

had incurred when first obtaining his licence. These costs were grouped under four main headings as follows :—

(1) Building or adapting cowsheds, (2) building or adapting dairies, milk rooms, etc., (3) extra equipment, and (4) loss on cows which reacted to the tuberculin test and the cost of replacing these with healthy stock. Much interesting information is given on the cost of the individual items in the improvement of cowsheds, equipment of dairies, etc., and there is an excellent discussion on the difficulties which confront the farmer who wishes to build up a tubercle-free herd.

There are obvious difficulties in calculating an average cost from the data collected because the amount of work to be done and the initial conditions with regard to the health of the herds showed marked variations; but in order to provide a basis for calculating the cost of " cleaning up " buildings and herds on a large scale, averages under the different headings have been determined and these are set out below for a farm where the milk is disposed of in bulk.

AVERAGE EXTRA COSTS PER COW.

	£	*s.*	*d.*
For Cowshed	6	19	0
" Dairy	1	5	8
" Equipment . . .	2	2	6
" the Herd . . .	3	3	0
	£13	10	2

Where the farm was equipped for the sale of milk in bottles, the average cost of equipment was approximately £4 19*s*. per cow.

The author points out that some of the work was carried out in years when building costs were higher than in 1936, and that probably the figures for buildings and equipment tend to be too high. On the other hand, he is of the opinion that the costs incurred in respect of the herd may well be below the actual average, because in all cases the farmers were able to take the necessary steps to get a herd which complied with the conditions. With these qualifications in mind, Dixey considers that £13 per cow is a fair average cost of " cleaning up " a typical farm.

Dixey also discusses the problem of a safe milk supply and points out that as some 35 per cent. of the cow population would react to the tuberculin test, and as approximately 35 per cent. of the total output of milk is used for manufacture, the milk from these cows might be directed to this end, leaving the milk from the 65 per cent. non-reactors to supply the liquid milk market. Unfortunately the fact that the reacting and non-reacting cows are found in the same herds makes this accidental similarity in percentages of no practical value.

Attested Herds.

The Attested Herds Scheme was introduced by the Ministry of Agriculture in February, 1935, to provide official recognition for herds which were found to be entirely free from tuberculosis. Herds which complied with the conditions of the Scheme were entered on the Roll of Attested Herds and owners of such herds in England and Wales became entitled to a bonus of 1*d.* per gallon for all milk sold through the Milk Marketing Scheme.

The name "Attested" must not be confused with the designation "Tuberculin Tested" as defined by the Milk (Special Designations) Order. The conditions set out in the Attested Herds Scheme take account of the freedom of the whole herd from tuberculosis, the methods of maintenance employed and the nature of the premises (including fields) occupied by the herd; but they disregard the cleanliness of the milk. The conditions governing the use of the designation "Tuberculin Tested" take account of the freedom of the cows from tuberculosis and other diseases likely to affect the milk, and require that the milk shall attain a specified bacteriological standard of cleanliness.

Owners of "Tuberculin Tested" herds have been exempt from the Milk Marketing Board levies (approximately 3*d.* per gallon) on all milk sold under the designation since the inauguration of the Milk Marketing Scheme in October, 1933[1], and this fact has, no doubt, lessened their interest in the Attested Herds Scheme.

The 1935 Scheme made slow progress, particularly in England, and a concise statement showing the rate of progress and the numbers and distribution of the herds which had become Attested up to January 31st, 1937, is given below. The details are taken from the four registers issued on the dates given (Ref. 14).

NUMBER OF ATTESTED HERDS IN 1935 AND 1936.

Date of Issue of Register.	England.			Wales.			Scotland.		
	No. of Herds.	No. of Animals.	Average per Herd.	No. of Herds.	No. of Animals.	Average per Herd.	No. of Herds.	No. of Animals.	Average per Herd.
31 Aug., 1935	24	1,092	46	7	176	25	27	2,267	84
31 Mar., 1936	49	2,243	46	32	1,041	33	88	6,922	79
31 July, 1936	68	3,245	48	49	1,585	32	144	11,826	82
31 Jan., 1937	88	4,232	48	120	3,712	31	256	21,025	82

The average number of animals per herd shows that in England, and particularly in Wales, the conditions of the Scheme have been found more easily attainable in the smaller herds than in the larger ones. In Scotland, on the other hand, the average attested herd is twice as large as in England and Wales. When considering the average size of herds it is essential to remember

[1] This exemption was withdrawn on September 30th, 1937.

that the numbers include stock of all ages, and as the number of young stock is approximately 50 per cent. of the total, the numbers of cows and heifers, in milk and dry, may be taken as half the above-mentioned numbers.

The Scheme was revised this year (Ref. 15) and amendments were introduced to take effect from June 1st, 1937; the object of these is to give some assistance to herd owners who wish to have their herds attested. Where the application of the tuberculin test, at the owner's expense, has shown that there are no more than 10 per cent. of reactors, and where the owner agrees to dispose of these immediately, to disinfect the premises and to comply with certain other conditions, the Ministry offers financial assistance for up to four subsequent tests, at the rate of 2*s*. 6*d*. per animal tested plus a flat rate of £1 1*s*. per herd. Herds accepted for further tests on this basis will be known as Supervised Herds. The payment of a bonus of 1*d*. per gallon for milk sold through the Milk Marketing Scheme is continued. The regulations regarding conditions of herd management, disinfection, and permits for additions to the herd, have not been modified; indeed it is difficult to see where these could have been relaxed without jeopardizing the success of the Scheme.

The Ministry of Agriculture has also announced recently that a campaign against tuberculosis and other diseases will shortly be launched (Ref. 16). Special efforts will be made to further the Attested Herds Scheme, with a view to the formation of attested areas. To assist in the development of the campaign on uniform lines it is intended to centralize the public (county) veterinary services. This proposal is of a far-reaching and almost revolutionary character, and details as to how the existing county veterinary services are to be dealt with are anxiously awaited.

The development from attested herds to attested areas (in which all herds will be free from tuberculosis) has been a natural and not difficult process in the United States, where the proportion of reactors is only some 10 per cent. or less. In this country, with its higher incidence of the disease (some 30 to 40 per cent.), and with the greater amount of movement of cattle from district to district and from herd to herd, the possibility of forming areas free from tuberculosis has, to the practical farmer at least, seemed remote. In districts with a dense cow population and few self-supporting herds, this may well be so; but there is evidence that, in rearing districts, the attested area is an ideal attainable in the near future.

In North Wales, Montgomerie and Rowlands report (Ref. 17) the results of applying the tuberculin test to almost all cattle over two months of age in four rearing districts. In all 2,270 cattle on 101 farms were tested and only 113, or 5 per cent., were found to be reactors. Analyzed in age groups the results

were :—over three years—647 cattle with 10·2 per cent. reactors; 2 to 3 years—253 cattle with 4·7 per cent.; 1 to 2 years—594 cattle with 1·8 per cent; 6 to 12 months—422 cattle with 3·5 per cent. and 2 to 6 months—354 cattle with 2·5 per cent. On 57 farms, *i.e.*, well over half the total, no reactors were detected, and on an additional 15 farms there were no reactors amongst the home-bred stock.

In an isolated valley in north-west Yorkshire, Rabagliati (Ref. 18) reports that on seven farms he tested 171 cattle and found only 13 reactors (7·6 per cent.) distributed as follows: out of 62 cows, 10 reacted (16·1 per cent.); out of 30 heifers, two reacted (6·6 per cent.); out of 74 calves, one reacted (1·3 per cent.) and five bulls all passed. Thomas reports (Ref. 19) that in 22 self-contained herds scattered over the county of Carmarthen, containing 662 cows, heifers and bulls, he found only 18 reactors (2·7 per cent.).

These results show that there are districts where the incidence of tuberculosis is so low that it should not be difficult to constitute attested areas. Progress in the formation and recognition of such areas should now be possible under those sections of the Agricultural Act, 1937 (Ref. 16) designed to promote the eradication of animal diseases, and particularly section 22, which gives the Minister of Agriculture power to make orders:

(*a*) Declaring any area as respects which he is satisfied that a substantial majority of the cattle therein are free from any particular disease to be an eradication area for the purposes connected with the control of that disease;

(*b*) declaring that any area as respects which he is satisfied that any particular disease of cattle is for practical purposes non-existent therein to be an attested area for purposes connected with the control of that disease; and

(*c*) prohibiting or regulating the movement of cattle into, out of or within any area which is for the time being an eradication area or an attested area.

II.—Dairy Cattle—Breeding, Type and Management.

Breeding and Progeny Testing.

During the last year there has been a reduction in the flood of publications dealing with progeny testing and the "proved sire." This must not be taken to mean that progeny testing was a "stunt" subject, in which interest was artificially stimulated for a short period and which is to be allowed to fade into oblivion. The truer explanation is that the essential value of progeny testing has now been more fully realized, and it has become necessary to think out with care the methods which should be adopted to obtain reliable progeny records and to consider how these records shall be interpreted and used.

An example of systematic work on breeding is found in the *Yearbook of Agriculture*, 1936, issued by the United States Department of Agriculture. This volume of over a thousand pages contains many articles dealing with recent developments in plant and animal breeding. To the dairy farmer three articles, dealing with different aspects of the breeding of cattle, contain much interesting material.

The first of these (Ref. 20) deals generally with the present position in live-stock breeding, and the view is expressed that "while the methods and practices of the past have accomplished a great deal, giving us the fine breeds of live stock we have to-day, yet these methods and practices have taken us about as far as they can. The most we can expect to do, if we continue to follow them, is to hold the gains that have been made." The circumstances which retard progress are discussed and grouped as follows :—

(1) *Confusion caused by questionable standards of excellence—e.g.*, the devotion of too much attention to mere show points, and the fictitious value placed upon a pedigree which is merely a list of the herd-book names and numbers of ancestors, and which gives no information on the merits of the individuals. (2) *The lack of real "yard sticks" to measure excellence.*—With dairy stock the weighing scale and the fat test have sufficed to measure production, but in judging health, or efficiency in the utilization of food, we make no more than a rough guess based on conformation. (3) *Gaps in our knowledge of animal genetics.*—We have some definite knowledge about the inheritance of certain characters of minor practical value, such as colour of coat, but we know little about the mode of inheritance of fertility, productiveness or vigour. "The lack of genetic knowledge puts the scientist in much the same position as an aviator in a fog who knows exactly where he wants to go but has no adequate instruments to guide him." (4) *Difficulties in carrying out experiments.*—These arise from the division of the sexes, the slow rate of reproduction in cattle, the initial cost of the stock and the cost of maintenance over a sufficient period of years. These difficulties must be gradually overcome, and future progress in live-stock breeding demands the co-operation of the scientific student of breeding and the stockbreeder himself with the purchaser of live-stock products, who can report on the suitability of these to meet the requirements of the consuming public.

Another article deals with the breeding of beef and dual-purpose cattle (Ref. 21). The difficulties confronting the breeder of cattle of dual-purpose type are discussed, and it is pointed out that these centre round the definition of the ideal at which the breeder aims. "The dairy part of the ideal is usually defined as the production of cows that will give 8,000 to 10,000 lb. of milk a year, when milked twice a day and given good farm care and

feeding. The beef part of the ideal is not at all well defined, though it is usually spoken of as the ability to produce a beef carcase that will grade 'medium' to 'good.' It is not intended that the two objectives should be realized simultaneously, that is, the cow that is giving large quantities of milk is not expected to be good material for the butcher at the same time, but it is intended that she shall possess the muscular basis and the physiological aptitude for converting her feed into beef when the stimulus for turning it into milk has ceased and that her sons shall be able to make reasonably good beef economically. . . . The cow that makes first-class cow beef in her old age, or produces steers that make good beef animals, must all her life carry more muscular tissue than is necessary to make her an efficient high-producing milk cow. The extent to which this extra load of muscular tissue may be incompatible with the production of large quantities of milk is a question that needs more careful investigation than it has yet received."

The definition given above and the problem stated in the concluding sentence apply in England as aptly as in the United States, and it is interesting to note that a survey of dual-purpose stock in the latter country, designed to discover animals carrying factors for both characteristics, could not be brought to a satisfactory conclusion because the only data obtainable consisted of milk records. To discover stock which possess by inheritance the essential dual-purpose qualities, it would be necessary for the milk records to be accompanied by measurements, in some form, of the fleshing qualities of the animals. Research on this matter has been initiated, but definte results have not yet been obtained. In England, dual-purpose cattle are more popular and more numerous than in the United States, and are also more important as sources of milk and meat, yet practically no attempt has been made to carry out any experiments to provide data for a breeding policy.

The third article describes the methods employed in a nation-wide survey to discover dairy herds with superior "germ plasm," *i.e.*, herds with high inherited and transmissable powers of milk and fat production (Ref. 22). ("Germ plasm" is defined as "the material basis of heredity, taken collectively," and an animal (or plant) with superior germ plasm may be defined as one that has hereditary factors for characteristics of genuine value and is therefore useful for breeding improved stock. A hereditary factor is sometimes called a "gene" and is the unit of inheritance transmitted in germ cells from parents to offspring.)[1]

[1] It is necessary from time to time to use new words to explain and convey new knowledge of breeding, but this should be no real difficulty to the many new farmers, who, in recent years, have learned the meaning of many new and essential words to describe parts of their cars or tractors.

The method of the survey was to distribute carefully prepared forms to a large number of herds where milk and fat records had been kept over a period sufficiently long to have proved at least two of the bulls used. Bulls were regarded as proved if they had five or more tested daughters without too much selection. The value of a bull was judged by the information on three points taken together, viz.: (1) the improvement in production of his daughters over their dams; (2) the proportion of daughters equal to or better than their dams; and (3) the relation of the production of the dams to the herd average. Numerical values were given to the results obtained in order to provide a basis for a broad classification of the bulls in one or other of five classes—excellent, good, fair, undeterminable and poor. Attempts to assign definite mathematical values to the transmitting ability of dairy bulls are, in the opinion of the authors, undesirable. Such efforts "are apt to bog down in a morass of records made soggy by corrections for this, that and the other."

Returns were ultimately received from 708 herds, spread over 40 different States, representing seven different breeds and including 42,799 cows and 4,309 sires. Of this total of bulls, only 2,242, or 52 per cent., were proved by having five or more tested daughters from tested dams; the number of dam-daughter pairs was 29,598 and the average yield of butter fat per lactation for the dams was 452 lb. (equal to 11,300 lb. milk with 4 per cent. fat) and for the daughters 451 lb.—a decrease of 1 lb. of fat. In 157 herds, however, there was evidence of increased production and in these the 8,728 daughters showed an increase of 26 lb. of fat (equal to 650 lb. milk with 4 per cent. fat) over their dams. These results may be disappointing, but it should be remembered that the survey was not directed to discover herds where proved sires alone had been used, but rather to assess the merits of all herds for which sufficient information could be obtained; moreover the herds surveyed were distinctly above the production level of the average for the United States, which is estimated to be only 158 lb. of fat (equal to 3,950 lb. milk with 4 per cent. fat) per cow.

In breeding dairy stock it is stated that the ideal is a continued sequence of good bulls to breed towards concentration of germ plasm for high production. It is recognized that it would be rather futile to advise the use of none but proved good bulls, because there are so few such bulls available. Evidence that the sons of proved good bulls have a better-than-average chance of possessing superior germ plasm, and thereby improving the herds in which they are used, has been obtained by placing young bulls in farmers' herds and noting the results. At Huntley, Montana, 49 such bulls (Holstein Friesians) had 579 daughters that gave 1,452 lb. of milk and 57 lb. butter fat more than their dams, and

only three of the 49 failed to increase the average yield of fat. Twenty-nine Holstein Friesian sires from another herd (belonging to the United States Government) had 370 daughters which gave 1,201 lb. more milk than their dams, and 27 Jersey sires from the same source had 224 daughters which gave an average increase of 46 lb. of butter fat over their dams.

A study of this American work, whose aim is to place the breeding of improved dairy stock on a better basis, naturally raises the question as to what is being done in this country.

In Scotland, McCandlish and Struthers have studied the milk records published by the Scottish Milk Records Association with the object of discovering proved sires, and have published lists of bulls (Ref. 23) each of which has had 10 or more daughters reaching a certain level of production. The standards used were 280 lb. butter fat for a cow or 224 lb. for a heifer in a lactation period not exceeding 52 weeks and where the animal in question calved again within 15 months. (These quantities of fat represent 7,000 lb. and 5,600 lb. milk (containing 4 per cent. of fat) respectively.) No information is given as to the *proportion* of the total number of daughters which have the above yields. In all some 880 bulls have been listed as "proven sires."

In England, the Shorthorn Society publishes annually a Register of Merit of Bulls (Ref. 24) each of which has had 10 or more daughters which have given, in lactation periods not exceeding 315 days, (*a*) 5,500 lb. milk if calving under 3 years 3 months; (*b*) 6,500 lb. milk if calving under 4 years 3 months; and (*c*) 8,000 lb. milk if calving at over 4 years, 3 months. No butter-fat qualification is required, and again no information is supplied as to the *proportion* of the total number of daughters which have given the specified yields.

The British Friesian Cattle Society also enter a bull in the Society's Register of Merit (Ref. 25) when not less than 10 of his daughters have given, in a lactation period not exceeding 365 days, milk yields up to or over specified minimum amounts varying with the age at calving. An average of not less than 3·5 per cent. of fat throughout the lactation is required. No information is given as to the proportion of the total number of daughters which have given the specified yields.

The Ministry of Agriculture, some years ago, prepared a scheme for the collection of progeny records of bulls, but for various reasons it has made very little progress. This scheme is now under review and it is hoped that, when the revised form is issued, every effort will be made by the Ministry, acting in conjunction with Breed Societies and Milk Recording Societies, to have progeny recording taken up throughout the country. Much information on the breeding value of bulls has been collected in the course of the official milk recording of many herds, and

if the necessary stimulus to the study of such records were forthcoming, a definite advance could be made in the use of progeny records in the breeding of dairy stock.

III.—The Composition of Milk.

Fat Percentage.

An interesting and extensive survey of the circumstances affecting the fat content of milk has been published by McCandlish (Ref. 26). The circumstances are classified according to breed, individuality, age, stage of lactation, etc., and the information collected by various authorities on the effect of each of these is summarized in a concise manner. Results are quoted from Eckles to show the effect of the condition of the cow at calving on the percentage of fat in the milk yielded during the subsequent lactation. The influence of condition at time of calving is greatest in the few months immediately after calving, but it has some effect throughout the lactation. McCandlish emphasizes that the easiest and most effective way of improving the fat percentage in the milk of individual cows is to get the cows into good condition before they calve. Many farmers have realized that cows in good condition at calving will give better yields than if they have calved in poor condition, but it has not been sufficiently realized that the fat-content of the milk is also improved. Where it is known that a cow tends to produce milk of low fat-content there is the greater need that she should have a reserve of fat in the body at calving time.

Vitamin Content.

The vitamin content of milk continues to be the subject of much research work, and a comprehensive summary on this subject has been published by Kon (Ref. 27). The dairy farmer in this country has, indeed, as yet only an academic interest in the subject because neither the demand for, nor the price of, milk is influenced by its vitamin content.

With regard to vitamin A, which is essential for growth, health and reproduction, it would appear from a number of experiments that those milks which are richest in fat are the most potent sources. Work by Gillam and others (Ref. 28) on the carotene (the parent substance of vitamin A) and vitamin-A content of the milk of four English dairy breeds indicates that, under similar conditions of feeding and housing, there are marked individual variations as between cows of the same breed. An examination of the butters of the four breeds studied showed the order of vitamin-A activity to be Guernsey, Friesian, Ayrshire and Shorthorn. This conclusion is qualified by the remark that the differences between the butters of the last three breeds were

found to be scarcely significant; further, only two cows of each breed were studied. The results also showed that the carotene and vitamin-A values are much more dependent on diet than on the stage of lactation.

A report from the Texas Agricultural Experiment Station (Ref. 29) states that Jersey cows on grass pasture secreted rich yellow butter fat, high in carotene content and vitamin-A potency, and that both these qualities diminished in proportion to the time that had elapsed after grass feeding ceased; there was a marked decrease in both qualities in six weeks' time. The addition of yellow maize meal to the ration had no appreciable effect on the carotene or vitamin-A content, but the addition of 3 to 6 lb. of alfalfa leaf meal was helpful in retarding the rate of decrease after grass feeding was stopped. The natural colour of butter fat from cows is directly proportional to the carotene content, yet the degree of colour is not an accurate measure of the vitamin-A content. It was also found that goats on green grass pasture produced nearly white butter fats of low carotene content but of high vitamin potency. The goat evidently differs materially from the cow in ability to convert the carotene of its foods into vitamin A, so that the colour of goat butter fat is of no value as an indication of its vitamin-A content.

Vitamin C, the absence of which causes the disease known as scurvy, is present in milk in the form of ascorbic acid and can be estimated by chemical methods. Kon and Watson (Ref. 30) found that, under south of England conditions, the season of the year and the nutrition of the cows had no effect on the vitamin-C content of the mixed milk of a herd, and that there was no definite difference between Shorthorn and Guernsey milk. The vitamin-C content of colostrum was only slightly greater than that of ordinary milk. Various workers in the United States found (Ref. 31) that cows of the same breed, and receiving similar diets, might produce milks showing wide variations in their vitamin-C (or ascorbic acid) contents; the stage of lactation appeared to have a more definite effect than any influences due to breed; the ascorbic acid content of milk was found to be relatively high during the early stages of lactation, but decreased to a minimum in about two months and increased to a maximum in the later stages of lactation. Other investigators (Ref. 32) report that the milks from cows on pasture, and from cows on indoor feeding with and without silage, showed no significant influence of the rations on the vitamin-C content.

The source of vitamin D in milk produced during the summer, and the comparative vitamin-D contents of Guernsey and Shorthorn milks, have been investigated by Kon and others. This vitamin is particularly associated with the absorption of the mineral matter required for bone formation, and its absence

causes rickets in human beings and animals. The vitamin-D content of milk is known to be higher in summer than in winter, but opinions have differed as to whether the summer increase is due to pasture, to the direct action of the sun, or to a combination of these two factors. By housing and feeding pairs of Shorthorn cows under controlled conditions it has now been shown definitely (Ref. 33) that the direct exposure of the cow to sun and sky-shine contributes all, and the pasture nothing towards the summer rise in the vitamin-D potency of milk. In another experiment (Ref. 34) the vitamin-D content of Shorthorn and Guernsey milk (both produced on pasture with s milar supplementary feed) showed some advantage in favour of the Guernsey milk, and it is suggested that the relative values of the two milks in this respect can be simply expressed by the ratio of their fat percentages.

There is general recognition that milk produced in winter will be improved as a food for infants and children if the vitamin-D content is increased, but the adoption of measures to bring about this improvement on a commercial scale has so far been limited almost entirely to North America. It is interesting to note (Ref. 35) that the Council of Foods of the American Medical Association approves of the fortification of milk with vitamin D and that, for the present, milk is the only common food in which such fortification will be recognized. If a demand for such milk should arise in this country there is a wealth of publications from which the necessary advice for its production can be obtained.

Although there is no demand in this country for milk rich in vitamins, it is well known that milk with a good cream line, and cream of a definitely "creamy" colour, are much more saleable than similar products lacking this colouration. This popular fancy has no definite connection with the fact that the creamy colour is due to carotene, but it has undoubtedly contributed to the spread of Guernsey and Jersey cows throughout England. This factor has also operated in the United States, and recently more attention has been given to the variation in the colour of milk from cows of the same breed and to the foods which will help to maintain a good colour during the late winter period (Ref. 36). Determinations of the intensity of colour in the milk of individual cows showed considerable variation, and no definite relationship to the percentage of fat in the milk. A low fat content is usually associated with low colour, but a high fat test does not always mean a high degree of colour. No new results of the effects of foods on colour have as yet been reported, but it is interesting to learn that a carotene concentrate fed at the rate of five ounces per cow per day had no significant effect in increasing the yellow colour. A number of owners of Guernsey

herds are co-operating with the New Jersey Agricultural Experiment Station in the systematic study of the colour of milk from different cows, with a view to the selection of strains which will normally produce a milk of high colour, and to the discovery of bulls whose daughters possess this quality to a greater extent than their dams.

IV.—The Management of Milk and Milk Utensils.

Milk for Pasteurization.

During recent years definite and often successful efforts have been directed towards the production of cleaner milk on farms, while at the same time there has been a marked increase in the proportion of milk which is pasteurized before delivery to the consumer. It is not necessary here to enter into a discussion of the advantages and disadvantages of the pasteurization of milk, apart from mentioning that the use of this process is essential if the consuming public in our large cities is to obtain sweet milk. In such discussions, however, critics of pasteurization have frequently advanced the point of view that an extension of this process will render the adoption of cleanly methods on the farm unnecessary, and that the attempts to raise the standards of production on farms will thus be stultified.

In this connection it is important to find that experienced dairy bacteriologists do not consider that pasteurization renders unnecessary the adoption of cleanly methods on the farm. Mattick (Ref. 37) quotes results which show that the bacterial plate count of samples of milk after pasteurization is definitely increased if the milk, previous to pasteurization, has been handled in unsterilized utensils and apparatus—milk pails, coolers, milking machines, etc. He points out that the addition of 1 per cent. of sterile milk to the culture medium used in plate counts has enabled results to be obtained which indicate more accurately the hygienic condition of the milk. The new medium (including the 1 per cent. of sterile milk) did not significantly increase the plate count of good raw milk, but with pasteurized milk the increases in the numbers of bacteria growing on the plates were often very large indeed. This result, arising from improved bacteriological methods, indicates that good milk is as necessary for pasteurization as for distribution in the raw state. Mattick adds that "the oft-repeated argument that pasteurization, if it became obligatory, would depress the standard of milk production can, therefore, no longer be sustained."

In a report of an investigation carried out by a large wholesale and retail milk company, Meanwell (Ref. 38) stresses the same conclusion. After emphasizing the importance of the adequate cleansing and steam sterilization of milk utensils and apparatus so as to reduce or eliminate those types of organisms with

marked powers of resistance to heat, he adds "the provision of a sound pasteurized milk supply of low bacterial content depends primarily on the cleanly condition of the raw milk delivered to the dairyman."

The practice which should be followed in the washing of milk utensils on the farm has been described in detail in numerous publications, one of which, issued by the Ministry of Agriculture as a bulletin and entitled "Modern Milk Production," is readily obtainable (Ref. 39). The practice in other countries is very similar, though sometimes the words and phrases used are different. Instructions to farmers issued by Michigan County Health Department (Ref. 40) contain some remarks which appear worthy of quotation—"Galvanized or granite-ware utensils are not suitable for milk purposes; a heavily tinned surface is best." "First rinse in clean cold water—a warm or hot water rinse will 'set' the milk solids, thus forming 'milk stone.'" "Washing should be done in water as warm as the hand can stand. Add a good washing powder. Soap or soap powder should not be used because it is rinsed off with difficulty and works very slowly on milk solids. Use a brush with fibre bristles and scrub thoroughly. A dish-cloth is very objectionable as it tends to smear and slide over the surface instead of scrubbing off the milk fats and solids." "Next rinse the utensils in warm or hot water to remove washing solution. The utensils are now physically clean and ready to be sterilized." "Proper care of the utensils after sterilization requires that they be stored on a sanitary metal rack inside a protected milk room. The sun is not a dependable sterilizing agent, for it cannot penetrate the inside of a can inverted on a paling fence; it shines only part of the time and any benefit is more than overcome by the exposure to dust, flies, birds and the weather."

The extent to which the temperature of milk is affected by the method of milking, and the relation of the temperature of the milk to the rapidity of straining, have been studied by Dahlberg and Durham (Ref. 41). The average temperature of hand-drawn milk was found to be 94·5°F., when that of the cowshed was 50°F.; when the shade temperature rose to 80°F., that of the milk was 97·5°F. (Normal temperature of cow, 101°-102°F.). Even with cows yielding only five pounds at a milking the temperature of the milk was over 90°F. Two milking machines gave different results; the milk drawn by one machine was only some 4° to 5° below that obtained by hand-milking, whereas the other gave milk which was 7° to 13° below the temperature of the hand-drawn milk. This result was due to the drawing of air directly into the milk tube. The rapidity of straining is influenced by the temperature of the milk, there being a marked diminution in the rate as the temperature falls. It is suggested

that variations in the temperature of the milk often account for the marked variations in the capacity of strainers using cotton discs or heavy straining cloths, and for the irregularities in the capacity of the same type of strainer on the same farm at different seasons of the year.

The Methylene-Blue Reduction Test.

An explanatory account was given in the last issue of this Review of the reasons which had led to the replacement of the plate-count test by the methylene-blue reduction test for the grading of milk under the Milk (Special Designations) Order, 1936. The latter test, though accepted by the Ministry of Health, has not earned the commendations of all dairy bacteriologists. Malcolm and Leitch of the West of Scotland Agricultural College (Ref. 42) report on the examination of some 10,000 samples of milk of farm and factory origin, made with the object of finding what degree of correlation might exist between the reductase test and the plate count. The results obtained cannot be regarded as favourable to the reductase test. In particular, it is stated that a considerable proportion of samples containing over 500,000 bacteria per millilitre may pass the accepted reductase test standards, especially during the winter; further, milk from cows suffering from mastitis is said to reduce the methylene blue very slowly; such milk, therefore, may receive a satisfactory report, though it is undesirable for human consumption and for the manufacture of cheese.

On the other hand, Nichols, also working in a Scottish laboratory on this test in relation to mastitis-infected milk, reports (Ref. 43) that so far as samples of mixed milk are concerned, if these samples contain milk from cows infected with streptococcal mastitis, the methylene-blue reduction test will not be diminished in value for routine grading.

On the more general question as to the suitability of this test for the purposes of the Milk (Special Designations) Order, Nichols and Edwards (Ref. 44) after careful comparisons of samples examined by the plate count and by the methylene-blue reduction test, come to the conclusion (1) that the results obtained by the latter show reasonable agreement with those obtained by the plate count, (2) that the reductase test shows as good an agreement with other measures of cleanliness as does the plate count, and (3) that the variability of the reductase test is less than that of the plate count.

Mattick (Ref. 37) also reports that in a recent large co-operative experiment, embracing a number of observers throughout the country, few samples of milk containing more than 200,000 organisms per millilitre, as determined by duplicate plate counts on milk agar, retain their colour for more than the

standard time of $4\frac{1}{2}$ hours in summer, and that few containing less than this number reduce methylene blue in less than $4\frac{1}{2}$ hours. He adds that "since judgment should never be passed upon the result of a single examination, it is likely that in the few anomalous cases the frequent examination of samples will be an insurance against misjudgment."

Apparatus and Methods for Fat Tests.

The desirability of determining the fat percentage in the milk of individual cows much oftener than is commonly done has frequently been emphasized by the Ministry of Agriculture, by breed societies and by prospective buyers of dairy stock from other countries. Milk Recording Societies provide the means whereby such samples can be taken, and arrangements have been made for the testing of the samples at numerous laboratories throughout the country. It is obvious that the results obtained in these laboratories should be reliable and uniform, and to facilitate the attainment of this end, definite recommendations regarding the apparatus to be used and the methods to be adopted have been issued by the British Standards Institution (Refs. 45, 46).

In the reports containing these recommendations it is stated that the Imperial Agricultural Research Conference of 1927 adopted a recommendation from their Committee on Dairying to the effect that information should be collected on existing methods and standards with a view to suggesting a practical scheme for the standardization of glassware for testing milk and milk products throughout the Empire. The initial steps on this were undertaken by the Dairy Research Committee of the Empire Marketing Board and, in September, 1933, when this Board ceased to exist, arrangements were made for the continuation of the work on standardization of apparatus and methods by the British Standards Institution.

With special reference to the testing of samples of milk for fat percentage, it is stressed that the use of standard apparatus and methods should enable all laboratories which use them to produce results which are comparable and of adequate accuracy for commercial needs. Successful results cannot be obtained if unreliable apparatus is used, and it is strongly recommended that apparatus used in this country for determining the percentage of fat by the Gerber method (and particularly butyrometers) should have been approved by the National Physical Laboratory as conforming to the adopted specifications.

V.—Cheese and Cheesemaking.

Mastitis and Cheese Faults.

Leitch (Ref. 47) comments on the fact that many experienced cheesemakers have found it increasingly difficult to produce

cheese of the best quality and that buyers of cheese find defects of more frequent occurrence than formerly; he also finds increasing evidence that the prevailing cause of these handicaps to the home cheese industry is the incidence of udder infections and, in particular, of sub-clinical mastitis.

It is well known that mastitis is common in many herds and there is ample evidence that mastitis-infected milk does not coagulate normally when rennet is added; that it gives a weak or soft curd and a slow-working cheese, with consequent loss of time and a loss of fat in the whey; and further, that such milk causes abnormal fermentations in the early stages of the ripening of the cheese, so that the texture of the finished cheese is too open, and discolouration and "off-flavours" also occur. The final result is a cheese of definitely lower quality from the graders' standpoint and therefore of lower market value.

Davis and Mattick have also discussed this subject (Ref. 48) and give a helpful list of references to reports by other workers on different aspects of the problem. They point out that, owing to the frequency with which mastitis occurs, it would be impracticable to exclude from the cheese vat all milk from cows suffering from mastitis in the technical sense, but that milk which is visibly abnormal should certainly be excluded. They advise the regular use of simple tests in the cowshed (such as the use of brom-cresol-purple papers or a strip-cup or black sieve-cloth) to detect infected milk. All such tests should be applied to the milk of each individual cow so that suspicious animals may be isolated and milked last, in order to lessen the risk of spreading the disease. Great care should also be taken to select the milk of cows with healthy udders for the purpose of starter propagation.

The systematic examination of dairy cows to enable owners to obtain an Accredited Milk licence will no doubt assist many herds to attain a higher health standard. There are already a number of instances where difficulties in the manufacture of cheese have largely disappeared since the detection and removal of cows suffering from mastitis became a recognized part of the herd management.

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REFERENCES.

1. *The Problem of Nutrition*, Vol. IV. Statistics of food production, consumption and prices. The League of Nations. (Ser. L.O.N.P., 1936, II, B.6).

2–5. *Scottish Journal of Agriculture*, Vol. XX, No. 1, Jan., 1937.
   2. ORR, SIR, J. B. Agriculture and public health.
   3. HALL, SIR DANIEL. A national plan for agriculture.

4. WATSON, J. A. SCOTT. Increased meat production.
5. KAY, H. D. Increased production of milk.

6. *Report and Accounts of the Milk Marketing Board*, for the year ending 31st March, 1937.
7. *Journal of the Ministry of Agriculture*, Vol. XLIV, No. 4, July, 1937.
8. *Amendment of the Milk Marketing Scheme*, 1933. Issued by the Milk Marketing Board, May, 1936.
9. *Milk. Report of the Reorganization Commission for Great Britain.* Ministry of Agriculture and Fisheries. Economic Series, No. 44.
10. The Milk Board's Policy on Reorganization. *The Home Farmer*, May, 1937.
11. *Milk Policy.* Cmd. 5533, July, 1937.
12. WRIGHT. An inquiry into the drinking habits of children of school age with special reference to milk drinking. *Bull. No. 7, Hannah Dairy Research Institute.*
13. DIXEY. Tuberculin-Tested Milk. A study of reorganization for its production. Agricultural Economics Research Institute, Oxford, 1937.
14. *The Register of Attested Herds.* Issues dated August 31st, 1935; March 31st and July 31st, 1936; and January 31st, 1937.
15. *The Tuberculosis (Attested Herds) Scheme (England and Wales)*, 1937. Ministry of Agriculture and Fisheries, May, 1937.
16. *The Agriculture Act*, 1937.
17. MONTGOMERIE and ROWLANDS. *The Veterinary Record*, Vol. 48, August 8th, 1936.
18. RABAGLIATI. *The Veterinary Record*, Vol. 48, Feb. 1st, 1936.
19. THOMAS. *The Veterinary Record*, Vol. 48, Feb. 29th, 1936.

20–22. *Year Book of Agriculture*, 1936. United States Dept. of Agriculture.

20. Live stock breeding at the cross-roads. By various contributors.
21. BLACK. Beef and dual-purpose cattle breeding.
22. GRAVES and FOHRMAN. Superior germ plasm in dairy herds.

23. McCANDLISH and STRUTHERS. A register of proven Ayrshire sires. *The Ayrshire Cattle Society's Journal*, Vol. 8, No. 3, Sept., 1936.
24. *Register of Merit for Bulls.* The Dairy Shorthorn Yearbook.
25. *Register of Merit for Production.* The British Friesian Herdbook.
26. McCANDLISH. The variations in the fat content of milk. *Bull.* 132, *West of Scotland Agricultural College.*
27. KON. The nutrition value of milk and milk products. *The Journal of Dairy Research*, Vol. VII, No. 2, May, 1936.
28. GILLAM and OTHERS. Variations in the carotene and vitamin-A values of the milk fat (butter) of cattle of typical English breeds. *The Biochemical Journal*, Vol. XXX, No. 9, Sept., 1936.
29. TREICHLER, GRIMES and FRAPS. The relation of the colour and carotene content of butter fat to its vitamin-A potency. *Bull.* 513, *Texas Agric. Exp. Station.*
30. RASMUSSEN and OTHERS. The effects of breed characteristics and stages of lactation on the vitamin-C (ascorbic acid) content of cows' milk. *The Journal of Nutrition*, Vol. XI, No. 5, May 10th, 1936.

31. KON and WATSON. The vitamin-C content of cows' milk. *The Biochemical Journal*, Vol. XXXI, No. 2.

32. RIDDEL and OTHERS. Influence of the ration on the vitamin-C content of the milk. *The Journal of Nutrition*, Vol. XI, No. 1, Jan. 10th, 1936.

33. CAMPION and OTHERS. The source of vitamin D in summer milk. *The Biochemical Journal*, Vol. XXXI, No. 1.

34. KON and HENRY. A comparison of the vitamin-D contents of Guernsey and Shorthorn butter (milk). *The Biochemical Journal*, Vol. XXX, No. 5.

35. The present status of vitamin-D milk. *The Milk Plant Monthly*, Feb., 1937.

36. BARTLETT, J. W. Breeding for colour in milk. *The Guernsey Breeders Journal*, Dec. 15th, 1936.

37. MATTICK, A. T. R. Applied bacteriology in dairying. *Journal of the British Dairy Farmers Assoc.*, Vol. XLIX, 1937.

38. MEANWELL. Management of raw milk supplies for pasteurization. *Dairy Industries*, Vol. 1, No. 5, Dec., 1936.

39. Modern milk production. *Bulletin No. 52, Ministry of Agriculture and Fisheries.*

40. Suggestions for the care of milk utensils on the farm. *The Milk Dealer*, Vol. 25, No. 8, May, 1936.

41. DAHLBERG and DURHAM. The temperature of milk immediately after milking and strainer capacity. *Bull.* 639, *New York State Agr. Exp. Station, Geneva.*

42. MALCOLM and LEITCH. The value of the methylene-blue reductase test in the grading of milk. *Scottish Journal of Agriculture*, Vol. XIX, No. 4, Oct., 1936.

43. NICHOLS. The methylene-blue reduction test as applied to milk infected with S. Agalactiæ. *Papers read at Conference of Agric. Bacteriologists*, 1936.

44. NICHOLS and EDWARDS. The comparative values of the plate count and the modified methylene-blue reduction test as routine methods for grading milk. *Journal of Dairy Research*, Vol. VII, No. 3, Sept., 1936.

45–46. *British standard apparatus and methods for determining the percentage of fat in milk and milk products by the Gerber method.*

45. Part I. Apparatus, No. 696—Part 1, 1936.

46. Part II. Methods, No. 696—Part 2, 1936.

The British Standards Institution, August, 1936.

47. LEITCH. Mastitis milk in cheesemaking. *Scottish Journal of Agriculture*, Vol. XIX, No. 4, Oct. 1936.

48. DAVIS and MATTICK. Mastitis in relation to cheesemaking. *Agricultural Progress*, Vol. XIII, 1936.

THE FEEDING OF LIVE STOCK.

I.—GRASSLAND PRODUCE.

Grass Drying.

THE steady development of interest in the problem of the better utilization of grassland that has been evident in these annual reviews since their inception has received a great impetus during the past year through the extension of the practice of the artificial drying of grass, and the official adoption by the Government of grassland improvement as a major feature of its policy for the rehabilitation of British Agriculture. That this growing interest is by no means confined to the British Isles is evident in the now voluminous annual output of reports on experiments, and was strikingly demonstrated also by the large assemblage of experts from all parts of the world at the Fourth International Grassland Congress held in Oxford and Aberystwyth. Grassland investigation may now indeed be regarded as a permanently established department of agricultural research, equipping itself rapidly with journals, textbooks and the other accessories essential to organized investigation.

On the scientific side, investigation bearing upon the improvement of the nutritional output of grassland, which is the ultimate goal, now ranges over the whole field of botanical, chemical and

management factors that are involved in the final result, but on the practical side attention has tended to concentrate upon the problem of the conservation of summer herbage for winter use by hay-making, ensilage or artificial drying methods.

Artificial drying in particular has caught the interest of the farmer, no fewer than 46 driers having been in operation during the summer of 1936 as compared with a dozen or less in the previous year. Experience thus far, however, has not been entirely happy as regards either the production or utilization of the dried grass, and has revealed problems still to be solved before the drier can establish its claim to a place in the normal equipment of even the large farm.

In this particular place we are not concerned with the technical problems of securing increased output, uniform drying and reduced working costs, but only with matters affecting the practical utilization of the product. From this point of view the case for grass-drying rests upon the nitrogenous character and high digestibility of the dry substance of young grassland herbage, together with its relative richness in essential minerals and in the precursor of vitamin A, carotene. This knowledge, apart from that relating to carotene, is by no means new, but the credit for its rediscovery and adaptation into a new technique of grassland utilization belongs to Woodman and his colleagues at Cambridge. For a historical review of the Cambridge work, the reader may be referred to Woodman's address to the Grassland Congress.

The basic feature of the Cambridge work was the demonstration that the dry matter of very young leafy grass contains anything from 20 to 30 per cent. of crude protein, and is highly digestible, so that *prima facie* there is reason to expect it to possess the nutritive qualities of a protein concentrate such as bean meal or perhaps linseed cake. The Cambridge work showed further that this high value is largely independent of the botanical composition of the herbage, and that, provided the grass is kept short, the value is maintained relatively constant throughout the season.

Subsequent repetition of this work in all parts of the world has confirmed this main thesis, although many variations in points of detail have been noted.

As a broad generalization, applicable over a wide range of conditions of region, soil and climate, it may now be said that if grassland of fair quality be cut over at intervals not exceeding about three weeks under average growing conditions (or with length of grass not exceeding 4–6 inches) the dry matter of the produce may be expected to contain from 15 per cent. upwards (and often over 20 per cent.) of crude protein, and to be digestible by ruminants to the extent of fully 75 per cent.

As the grass grows, however, the protein content and nutritive value steadily fall, until by the time it has reached the stage at which it would normally be cut for hay the dried product obtained from it is, in fact, hay—good hay certainly, but none the less hay and no longer a "concentrate."

Herein lies one of the major difficulties of the farmer who wishes to make dried grass as a substitute, part or entire, for concentrates. Regulate the cutting and drying of his grass as he may, the protein content and nutritive value of his dried grass will vary more than that of the concentrates he is wont to purchase in the form of cakes and meals. In a season of relatively slow growth the bulk of his produce may perhaps fall into the "concentrate" class, but in a season of rapid growth he will get the whole range from the 20 per cent. protein quality down to a 8–10 per cent. quality which he must regard as hay. This has already been recognized by the Association of Dried Grass Producers in their classification into the following four grades :—

Grade I.—Dried Grass, 17% protein or more (in dry matter).
„ II.— „ „ 14–17% protein or more.
„ III.— „ „ 12–14% „ „ .
„ IV.—Super Hay.

Whether a trade in dried grass, if it develops, can be worked with reasonable conformity to these standards remains to be seen, but it will certainly be more difficult to regulate than the trade in ordinary concentrates.

Up till recently the claims as to the utility of dried grass as a substitute for cakes and meals were based mainly upon data for chemical composition and digestibility, but the volume of experience from its practical use in feeding experiments and on the farm is steadily growing. This, in the main and in the case of cattle and sheep feeding, seems to be confirming the predictions based upon chemical analysis, provided a satisfactory consumption and normal digestion have been secured; but exceptions are not lacking in which, for reasons not always obvious, the dried grass has failed to function effectively. In the case of pigs and poultry there would seem to be narrow limits to the amount of dried grass that can be adequately dealt with, but in the case of feeding cattle and dairy cows experience as yet seems to be rather widely divergent, some feeders claiming to have supplied the whole of the "production ration" successfully in the form of dried grass, whilst others profess disappointment with the results of only a partial replacement of concentrates by dried grass. The point will eventually be decided by careful tests, but until the results of these are available the feeder who wishes to use dried grass can only be advised to introduce it gradually into his rations, increasing the amount slowly until

there are obvious signs that further additions will be either wasteful or possibly detrimental.

The value of dried grass in relation to other feeding stuffs will vary to some extent according to the purpose for which it is required. Judged simply in terms of its general nutritive value, as expressed mainly in its protein content and starch equivalent, it may reasonably claim the full value indicated by its content of digestible ingredients, especially as the "quality" of its protein (if from spring grass at any rate) is high. If, however, special value for its intended purpose attaches to its vitamin content (as in poultry rearing) or to its property of colouring milk, some addition in respect of this must be made to the estimate of basic value. It may well appear worth £1 per ton more to the producer-retailer of milk than to the bullock feeder.

For a general review of the present position of the grass-drying movement in this country reference should be made to the report by E. J. Roberts issued by the Agricultural Research Council (Ref. 1). The concise review by Earl Waldegrave and W. T. Price (Ref. 2) will also be found helpful.

On the present position of knowledge with regard to the practical possibilities of using dried grass as "production food" for live stock, the conclusions from a review by Watson ("Agricultural Progress," Vol. XIV, 1937, p. 155) may be quoted: "It may be said that artificial drying gives a product equal in feeding value to the original crop. Its use in the feeding of stock will therefore be decided by the advantages or limitations of the original material. We know that it can be fed to the dairy cow with every success, and the problem here is one of management, to get good quality material and adequate experience to be able to recognize the variations and the capacity to store and use them separately. There are indications that there are limits beyond which it cannot be fed to the pig. It is a safe and excellent food for young stock. There is a dearth of accurate information on its use for such stock, other than observational data, and this also applies to older and fattening stock. Its use for sheep seems promising, and it is eaten readily. We know little about its value for horses. It is obvious, therefore, that a good deal of accurate work is still needed in the feeding of dried grass, but the main problems are, first, the economic one of reducing cost of production to the lowest possible level and, second, the proper management of the grassland to produce the greatest bulk of the most valuable fodder."

Other Methods of Conservation.

That artificial drying is unlikely ever to be able to cope with more than a fraction of the grassland produce that needs to be conserved for winter use is surely obvious, not only on technical

and economic grounds, but also because of the necessity for a proportion of "roughage" in the winter rations of cattle. The alternative methods of conservation by hay-making and ensilage must always therefore command the interest and attention of the investigator, and each year brings a series of reports.

The haymaking process is satisfactory only for the conservation of the mature crop, but ensilage can be applied over a wider range of growth-stage and is regarded seriously by many investigators as an alternative to artificial drying for comparatively young material. For material relatively rich in protein, however, the ordinary process of ensilage is not reliable.

With materials such as young grass, that are comparatively rich in protein and consequently not rich in fermentable carbohydrates, it is not always possible to get a sufficiently rapid formation of lactic acid in the silo, and therefore either the lactic fermentation must be stimulated by an addition of fermentable carbohydrates, or the desirable degree of acidity must be secured by appropriate additions of acid. The latter method is that adopted in the now familiar A.I.V. process, in which the material is watered with a dilute solution of mineral acids during the process of filling. For the purpose of the alternative type of method molasses forms a useful source of carbohydrate that can be conveniently distributed through the mass of ensiled material. Whey has also been used for this purpose, but only with success when applied in relatively concentrated form.

It will be noted from results quoted below that the consensus of opinion from experimental work favours the molasses method as probably the best for farm use.

As an appendix to this survey of the general aspects of the problem of utilization of grassland produce some of the more interesting results of experimental work published during the year may now be summarized.

Composition of Grasses.

Investigations at Rothamsted (Ref. 3) have revealed the presence in young ryegrass of considerable quantities of a soluble sugar-like carbohydrate of the fructose type. This formed at one stage more than one-third of the dry matter of the plant, but the proportion fell rapidly with advancing growth, whereas the proportions of the insoluble carbohydrates, cellulose and lignin, rose. It appears probable that this difference in the character of the carbohydrates may play a considerable part in explaining the higher nutritive value of young than of old grass.

At Aberystwyth (Ref. 4) grazing tests with sheep have shown: (1) that the addition of wild white clover to grasses increased the live-weight gain by nearly 30 per cent. and the carrying capacity of the pasture by 15 per cent.; (2) that perennial ryegrass

was 14 per cent. more productive in live-weight gain than cocksfoot, but had only the same carrying capacity over the season; and (3) that the complex mixture of indigenous seeds tested was much better in both respects than a corresponding mixture of commercial strains.

The increase in live weight per grazing day was greater in dry than in wet years, but the total gain per acre for the whole grazing season was greater in wet than in dry years, because of the longer grazing period.

In East Prussian experiments (Ref. 5) tests were made of the digestibility (by sheep) of pure strains of perennial ryegrass, brome grass and meadow fescue, with the following average results :—

	Dig. Crude Protein. %	Starch Equivalent. %
Perennial Ryegrass	5·16	39·2
Brome Grass	5·74	33·4
Meadow Fescue	6·50	35·8

It is remarked that hay from perennial ryegrass when fed to cows imparted a typical bitter taste to the milk and butter.

Similar tests made at the same centre with a clover-grass mixture, cut at four stages of growth (Ref. 6), showed the familiar fall of nutritive value, with fall of protein and digestibility and rise of fibre, as growth advanced; but the further observation was made that the rate of decrease in digestible nutrients from stage to stage was much slower if the material were ensiled or fed green than if made into hay. The losses in ensilage were very small, whereas losses in making into hay amounted to as much as one-third of the protein and one-half of the starch equivalent of the green crop. Drying losses were greater with early-cut than with late-cut material.

Examination of the changes in chemical composition of herbage on grazed and ungrazed plots at Cockle Park (Ref. 8) has led to the conclusion that "the practice of laying up grass for winter keep affords a useful means of conservation which might be more widely used in districts with moderate conditions of climate." It was found that the crude protein content of the grass declined between October and November on grazed and ungrazed plots alike, but rose in late winter when the grass began to grow again. Digestibility of the herbage was at its lowest in January, the decline being accentuated on the ungrazed plot. The mineral content of the herbage on both plots showed marked seasonal variations and fell steadily throughout the experimental period. Judged by chemical composition, the nutritive value of the winter grass was inferior to that of summer grass from the same pasture and of the age at which it is normally grazed. The mineral efficiency of the winter grass, however, was relatively high, and "compared favourably in this and other respects with

month old summer grass from inferior Boulder Clay pastures, and with hay from one of the best meadow plots at Cockle Park."

German experiments (Ref. 9) on the effect of liming upon the composition of grass showed an increase in protein, fat, fibre, total minerals, lime and phosphoric acid and a decrease in soluble carbohydrates. The increase in lime-content of the herbage was quite regular, but the effects on protein and phosphorus rather variable. In most cases liming also raised the digestibility of the herbage.

Some rather curious observations are reported by Greenhill (Ref. 10). Although, as might have been expected, grass cut between noon and 3 p.m. contained less moisture than if cut earlier (owing to the removal by evaporation of the dew from the external surfaces), there appeared to be, apart from this, a diurnal variation in the yield of herbage according to time of cutting. The highest yields were obtained at the first morning cut; then lower at noon, and rising again in the afternoon under rainy conditions, but remaining at the noon level in dry weather. The differences were only small and not statistically significant, and therefore require further confirmation.

Haymaking.

A valuable report by the Jealott's Hill staff (Ref. 11) gives the results of five years' experiments dealing with the question of the time of cutting grass for hay and the losses in haymaking. In each of the years 1930–35 comparisons were made of the weight of hay cut at the normal time with that of the produce obtained by cutting 3–5 weeks earlier *plus* the weight of aftermath grown in the intervening period. As was to be expected, the early hay showed the better composition and digestibility, its average crude protein content being 12 per cent. as against 7·9 per cent. for the normal hay. In yield of dry matter and in starch equivalent, however, the advantage lay with the normal hay. On the average of five years the ordinary hay yielded 249 lb. per acre more starch equivalent and 47 lb. less protein equivalent than the early hay (plus aftermath). If the aftermath included with the early hay be deducted, the corresponding differences become 522 lb. and 11 lb. respectively.

The losses (average of four years), that occurred during haymaking and curing in the stack are summarized below in the form of percentages of the original fresh material:—

Type		Dry Matter	Starch Equivalent	Protein Equivalent
Early Hay:	In field	18·0	34·5	23·0
	In stack	5·2	6·8	9·0
	Total	23·2	41·3	32·0
Ordinary Hay:	In field	14·3	26·7	33·7
	In stack	5·7	5·3	+ 4·3 (gain)
	Total	20·0	32·0	29·4

Adverse weather conditions caused high losses, amounting in the worst case to 36·7 per cent. of the dry matter, 58·7 per cent. of the starch equivalent, and 53·7 per cent. of the crude protein. The weather conditions were, in general, more favourable in the normal haymaking periods than in those during which the early hay was made.

In a further comparison, made in 1935, of ordinary windrow drying of seeds hay as against the tramped heap or pike, little difference in composition was found between the two products, but the piked hay was slightly more digestible and gave a rather higher yield of starch equivalent than the windrow-dried hay. Poor weather conditions caused heavy losses in the field, which were rather greater in the windrows than in the pikes; but in the stack the piked hay lost slightly more protein equivalent. The total losses of starch equivalent and protein equivalent in this test were approximately 60 per cent.

In another report from the same source (Ref. 12) evidence is adduced that the assumptions commonly made as to the protein content and general nutritive value of average hay are unduly optimistic. In the winter of 1935, 22 samples of hay, made under good conditions in the preceding summer, were obtained and tested for composition and digestibility. Out of 21 samples, 5 were described by the growers as *very good*, 9 as *good*, 4 as *fairly good*, 1 as *average*, and 2 as *fair*. Thus, in the farmers' opinion the average quality of the samples was distinctly good. Below are given the average analyses of the 22 hays alongside the "standard" averages for "poor," "good" and "very good" hay as given in the Ministry of Agriculture's bulletin on "Rations for Live Stock":—

	Average of 22 Samples of 1935 Hay	As published in "Rations for Live Stock"		
		Poor	Good	Very Good
	%	%	%	%
Crude Protein . . .	7·58	7·43	9·62	13·66
Ether Extract (oil) . .	1·49	1·49	2·48	3·04
Fibre	28·71	33·23	26·08	19·53
Ash	6·44	4·96	6·15	7·79
N-free Extract (Carbohydrates)	40·78	37·89	40·67	40·98

It will be seen that on crude composition the 1935 hay could at best be classified only as intermediate between "poor" and "good." The crude protein varied in the individual samples from 4·8 per cent. to 12·9 per cent. of the dry matter, with an average of 8·9 per cent. When the comparison is based upon digestible ingredients, the average still remains "poor" as regards digestible protein, but equal to "good" in terms of starch equivalent. Judged by the latter criterion, 2 of the samples might be described as "very good," 12 "good," and 8 intermediate between

"good" and "poor." Judged by content of digestible protein equivalent, none of the samples could be described as "very good," 5 were "good," 6 intermediate between "good" and "poor," and the remaining 11 definitely "poor."

It is evident that practical opinion as to the value of hay may be seriously at variance with the evidence of composition and digestibility, and that the latter should be made more readily available to farmers. The ordinary analysis of hays presents no serious difficulty in this respect, but it is, unfortunately, a costly and lengthy business to determine digestibility.

The authors suggest, therefore, that the required data as to starch equivalent and digestible protein equivalent should be calculated from the crude composition of the hay, using the following formulæ deduced from their examination of the 22 samples of the 1935 crop:—

$$\begin{aligned} &\text{Starch Equivalent (S)} = 87{\cdot}645 - 0{\cdot}6875x \\ &\text{Protein Equivalent (P)} = 0{\cdot}7844y - 3{\cdot}331 \\ &\text{where } x = (\text{Crude Fibre} \times 2) + (\text{Crude Protein}) \\ &\qquad \text{and } y = \text{Crude Protein}, \end{aligned}$$

all percentages being calculated to dry matter basis. For example, if a hay with 15 per cent. moisture contained 28·7 per cent. fibre and 7·6 per cent. crude protein, this would mean 33·8 per cent. fibre and 8·9 per cent. crude protein in the dry matter. Using now these latter data in the above formulæ, we should arrive at the starch equivalent of the dry matter as 35·1 per cent. and its content of digestible protein equivalent as 3·67 per cent.

Whether these formulæ will prove to be sufficiently reliable for general use remains to be seen, but they can in any case only apply to meadow hay as normally cut and won on the farm—probably not to seeds hay, and certainly not to young grass.

Swedish experience (Ref. 7) accords with British as to the superiority of relatively early cutting over late cutting of grass for hay. Optimum results were obtained on timothy-clover meadows when the timothy was in full bloom and the flowering of the clovers well started. At this stage the yield of protein was 15–17 per cent. higher than with late cutting.

Before passing to deal in the next section with problems of ensilage, reference may be made to a few Continental reports on investigations in which haymaking methods have been compared with ensilage.

One such report comes from a German source (Ref. 13) and deals with the losses involved in conserving clover and meadow grass by different methods. The "haymaking" methods included mechanical drying under cover, ordinary drying on the ground, drying on tripods and other forms of racks, and drying on wires. Silage was made by an acid process, using hydrochloric

acid. The composition and digestibility of all products was determined.

The average losses of starch equivalent and of protein are given below :—

	Starch Equivalent.	Digestible Crude Protein.
	%	%
Ensiling	8·2	5·0
Drying on Wire	33·4	14·5
„ Tripod	36·9	29·7
„ other racks	38·6	20·7
„ ground	41·4	32·7

The losses in ensiling were clearly much lower than with any method of haymaking. Among the good quality hays the digestibility was much the same for all samples, but on the whole the best quality hay was obtained by drying on wires and the worst by drying on the ground, especially in bad weather. A feeding trial with cattle showed that the hay dried on tripods had 69 per cent. of the nutritive value of the same amount of original grass made into silage. This accords well with the results of the digestion trials.

From Denmark comes also a series of reports (Ref. 14) on experiments dealing with the conservation of grassland and green fodder crops. The experiments extended over five years and included both haymaking and ensilage, the material used being mainly clover-grass mixtures cut early in the flowering stage. In these experiments the average loss of dry matter from hay (13·9 per cent) was only slightly greater than from A.I.V. silage (11 per cent.), the corresponding figures for loss of crude protein being 22·5 per cent. and 18·7 per cent. respectively. These differences were, moreover, offset by the fact that about 5½ per cent. (on dry matter) of the silage had to be thrown away because of spoilage at the surface and sides of the silo.

Hay dried on racks contained slightly more dry matter than did hay from cocks, but in large-scale feeding experiments no significant differences were found between the products obtained by the different methods.

In a comparison of hay with A.I.V. silage, in which 105 cows were fed on each ration, there was a small difference in favour of silage, 5·93 kg. of dry matter in the latter proving fully equivalent to 6·76 kg. of the dry matter of hay.

Tests with small and large rations of hay showed that 6·38 kg. of the dry matter of hay could replace a mixture of 2·06 kg. concentrates, 1·9 kg. roots and 4·5 kg. straw. This corresponds to a starch equivalent of 37 for the dry matter of the hay.

Digestibility was found to be greater in fresh red clover than in either the hay or the silage made from it, the reduction in the digestibility coefficient of the organic matter being 11 points

as between fresh clover and hay, and 6 points as between the fresh clover and A.I.V. silage made from it.

Ensilage of Grass.

During the year several reports have been issued dealing with the new methods of ensilage of young grass to which reference was made in an earlier paragraph. Reference may first be made to data reported from Jealott's Hill (Ref. 15), which are based upon 258 samples of ensiled grassland herbage, of which 65 samples were produced by the ordinary method without additions, 38 with added molasses, 4 with added whey, and 143 by the A.I.V. process. Data on a few silages made from other materials are also included in the report. The chemical nature of the products was examined in considerable detail, but we can only touch here upon some of the observations that are of direct practical interest.

The external characteristics of the silages varied with the acidity of the material, the more acid samples retaining to some extent the green colour of the grass and giving off only a faintly acid smell, whilst at the other extreme the silages of low acidity were dark brown in colour and strong smelling. The molassed silage is very favourably reported on as having, at all acidities, the characteristic sweet odour of the molasses, without any tinge of butyric acid. The smell of the A.I.V. silage was more variable, being quite pleasant at the higher acidities, but increasingly like that of ordinary silage as the acidity fell. The general conclusion is drawn, however, that ensilage of grass by the A.I.V. process "results in the production of a foodstuff of excellent quality, in which the breakdown of protein and the formation of organic acids, which is so characteristic of ordinary silage, is markedly reduced, though not to the extent which might be expected."

A much less favourable conclusion is drawn as to the merits of the ordinary process of ensilage, especially for the younger type of grass material in which the crude-protein content is relatively high.

The highest commendation is given to the molasses process, in which 15–25 lb. of molasses, suitably diluted with water, was used per ton of fresh grass. Whilst superior in general attractiveness, this type of silage was little inferior in its chemical characteristics to that produced by the A.I.V. process. The chief disadvantage is apparently that the breakdown of protein is rather greater than that obtaining with the A.I.V. process. The use of molasses is nevertheless recommended where silage of high protein content is being made. Considerable stress is placed upon the exercise of the greatest care in trampling the fodder, teasing it out, and allowing time in filling for individual layers, particularly in the bottom of the silo, to warm up to about 80°F.

The study of the losses of nutrients incurred in the conversion of grass into silage by the different processes led to the conclusion that, whilst some reduction of loss is effected by the molasses and A.I.V. treatments as compared with the ordinary method, the differences are of no great practical significance, since the losses in the ordinary method, properly applied, can be kept down to a low level, even where material of fairly high protein content is used. The real advantage of the other methods lies in the greater reliability of the product.

These conclusions are broadly confirmed by results obtained at Harper Adams College (Ref. 16), from which a general opinion in favour of the molasses process is expressed. Ordinary, molassed and A.I.V. grass silages were all found, at this centre, to be palatable to cattle, but sheep did not take readily to the A.I.V. silage. In the ordinary silage the digestibility of the dry matter was 60·3 per cent., in the molassed silage 64·3 per cent., and in the A.I.V. silage 71·8 per cent. The protein was best conserved in the A.I.V. silage, and the carbohydrates in the molassed silage, which latter also showed the lowest loss of total dry matter. On the other hand, conservation of total digestible nutrients and of starch equivalent was highest in the A.I.V. silage.

Welsh experience (Ref. 17) in the making and use of acid and molassed silages was even more favourable to the latter. In these experiments the silage made from grass by the ordinary method, without additions, proved quite unsuitable, whilst that made by acid processes, though apparently of good quality, was not as readily eaten as the molassed silage. As compared with similar material made into hay, the losses were much less in the ensilage processes. Stress is placed in this report upon the state of maturity of the crop as being a factor of the highest importance in making silage by any process. The less mature the crop, and especially if it is wet, the greater will be the difficulty of getting a good product, and the greater the advantages of the new methods over the old.

Molassed silage also receives commendation in an American report, as being palatable and because it can be made with little loss of nutrients. A warning is given, however, that the process is not suitable for material of relatively low moisture content, such as partly dried grass.

In contrast to the foregoing British and American experience, Danish investigators (Ref. 14) have reported adversely upon the molasses process, which in their hands showed much greater losses than the A.I.V. process, and also showed far-reaching breakdown of protein, even to ammonia. This is so directly at variance with experience elsewhere that it need not be taken too seriously unless confirmed later.

To sum up, as between the A.I.V. and molasses processes

there is apparently little to choose on grounds of efficiency of food conservation and quality of product; but on grounds of cost, safety, convenience of application and palatability of product, the advantage would seem to lie definitely with the molasses process. Neither process need be considered, however, if the crop to be ensiled is at a fairly advanced stage of growth, since such material can be satisfactorily dealt with by the ordinary method.

Comparison of Dried Grass and Silage.

Under this heading may be noted a further report from Jealott's Hill (Ref. 18) on comparative tests of the value of artificially dried grass, molassed grass silage and A.I.V. grass silage in the diet of dairy cows. The various products used contained in all cases 17–20 per cent. crude protein in the dry matter and were thus of high grade. No significant difference between the effects of the three rations was found with respect to milk yield, yield of butter fat, percentage of fat, or live weight, but there appeared to be a significant lowering in the percentage of solids-not-fat in the milk from the A.I.V. silage ration as compared with that from the dried grass ration. The non-fatty solids were, in fact, low all round, and only the dried grass ration showed an average percentage of non-fatty solids in excess of the 8·5 per cent. standard.

At the level fed the dried grass replaced its equivalent of starch equivalent and protein equivalent given as concentrates in the control ration. This is interesting in view of the fact that the dried grass (about 8 lb. daily) supplied about one-half of the digestible crude protein in the whole ration, the proportions being also much the same in the two silage rations. The proportion of "amides" included in the "crude protein" was thus considerably greater in these rations than in the control ration, in which the place of grass or silage was taken by ordinary concentrates. The proportions of the digestible crude protein of the total rations that were present as "amides" were, in fact, 5·9 per cent. for the dried grass ration, 31·4 per cent. for the molassed silage ration, and 25·0 per cent. for the A.I.V. silage ration. The fact that the yield and composition of the milk were so well maintained suggests that under the conditions of these experiments the value of the "amides" of grass, as protein substitutes, must have been greater than is commonly assumed.

In all cases the carotene content of the milk, and therefore its vitamin A potency and yellow colour, were raised to a level similar to that of the average of the grazing season for pasture-fed cows, though in contrast to previous experiments the A.I.V. fodder was not so efficient in this respect as the other two foodstuffs.

II.—Lucerne.

In supplement to the preceding survey of grassland problems, the results of a few investigations upon the lucerne crop may be reviewed.

A Danish report (Ref. 19) gives the results of precise measurements with two cows of the nutritive values of three types of dried lucerne, namely: (1) dried on the ground in the ordinary way; (2) dried artificially at low temperature; and (3) dried rapidly at high temperature. The various products contained (in the dry matter) from 18·6 to 21·0 per cent. of crude protein, and were thus of high quality. Digestible protein in the dry matter of the three products was found to be 10·1 per cent., 12·34 per cent. and 12·0 per cent. respectively, whilst the net energy value per kilogram of dry matter was found by respiration experiments to be 1,108, 1,216 and 1,201 large calories respectively (corresponding in starch equivalents to 46·9 per cent., 51·4 per cent. and 50·8 per cent.). The two artificially dried products were thus a little better than the "hay," but in view of the high quality of the latter it is not surprising that the difference was only small.

In the case of lucerne, as with grass, considerable importance attaches to its capacity to supply vitamins and to conserve these during storage. Much of the recent work on lucerne has dealt with this aspect, and may be illustrated by two American reports.

In experiments at the Colorado Experiment Station (Ref.20) the vitamin A content of alfalfa hay, dried in the ordinary manner in diffused light, was found to be 40 per cent. less than in similar material dried by artificial heat. During storage in airtight tins at ordinary temperatures the vitamin A value of chopped alfalfa hay deteriorated by 28, 31 and 68 per cent. after 14 months, two years and three years respectively.

That greater and more rapid loss may take place under ordinary conditions of storage is illustrated by observations made in Arizona (Ref. 21) that during the first three months of ordinary storage, from August to November, there was a loss of 50 per cent. of the vitamin A activity. In the next three colder months no further destruction occurred, but with the rising temperature in the spring the deterioration recommenced, and after twelve months' storage the hay retained only 25 per cent. of its original vitamin A activity.

The Colorado report also includes information on the occurrence of the two chief vitamins of the B group (B_1, and B_2) in alfalfa hays. Apparently the content of these vitamins is low, the B_2 being relatively more abundant than the B_1 vitamin. The latter was best preserved by rapid drying in warm air, or by slow drying without exposure to sunlight; storage in stacks

in the open was less satisfactory. The vitamin B_2 was apparently more stable and was not affected by various methods of drying. There is a general consensus of opinion now, however, that vitamins of all kinds, with the possible exception of vitamin D, are much better conserved by the modern heat-drying processes than by natural haymaking methods.

III.—Protein Supply.

In the great field of protein investigation, three types of problem have a direct bearing upon farm feeding, namely: (1) the "amide" make-up (or "quality") of proteins; (2) the ability of ruminants to utilize "amides" in place of protein; and (3) the protein requirements of the various classes of live stock for maintenance and production.

Protein Quality.

The factors that determine differences of quality as between different proteins (and the mixtures of proteins occurring in different feeding-stuffs and rations) have been explained in previous Guides (1931, p. 81; *Jour.*, Vol. 94, p. 283; Vol. 95, p. 296), and it must suffice here to recall that the differences between different proteins are determined by the nature and amount of the structural units (amino-acids, amides, etc.) from which they are built up in the plant, and into which they break down in the digestive tract of the animal. These are the units out of which the animal then builds up the proteins it requires for the maintenance and growth of its body or for the manufacture of milk, eggs, etc.

Some of these "structural units" (which we will call "amides," for short) are absolutely essential for growth and most other purposes, and must therefore always be present in adequate quantities in the digesting food; others are less important in that their absence or deficiency can apparently be made good by the animal from the other nitrogenous constituents available.

Of the essential "amides" the best known are *lysine*, *histidine*, *tryptophane* and *cystine* (a sulphur-containing "amide"), and much of the work that is being done in this field of protein research is being concentrated upon these ingredients.

Recent Russian work, for example (Ref. 22), has shown that the protein of egg yolk contains more lysine and histidine, but less cystine, than the protein of egg-white; that milk protein as a whole is well supplied with lysine, but poor in tryptophane and cystine; also that the protein of peas includes all the essential "amides," but is relatively poorly equipped with tryptophane and cystine.

In farm practice the "amide" make-up of the proteins of a particular feeding-stuff is chiefly of interest in relation to the ration to which it is to be added. If the protein of the feeding-stuff is relatively rich, say in lysine, then it may clearly be

expected to produce a more marked effect if added to a ration whose protein is deficient in lysine than if added to another ration whose protein is already adequately supplied with this ingredient.

Such at least is the theory, and experiments on milk production at the Hannah Dairy Research Institute (*Jour.*, Vol. 95, p. 298 ; Vol. 96, p. 302) and on wool production in Australia (*Jour.*, Vol. 95, p. 304) have demonstrated its validity under certain conditions in practice. That it does not always work out so simply, however, seems evident from the negative result obtained in an experiment at Reading (Ref. 24). In this experiment with cows, using a basal ration with protein not only lower in amount but poorer in lysine than " most rations normally used in English farming practice," the effects of additions of equal amounts of protein in the form of blood meal and wheat gluten respectively were studied. Gluten is much poorer in lysine than is the protein of blood, and therefore the latter might have been expected to show to advantage. In the event, however, apart from an apparent slightly beneficial effect upon the live weight of the cows on the blood meal ration, no difference could be detected between the effects of the two rations. It is noted, however, that in a subsidiary experiment a large increase in the dietary protein produced only a very small and non-significant increase in the milk-yield. Possibly, therefore, there was, after all, little or no deficiency of lysine in the protein supply of the basal ration, although, judged by current data for the ingredients used, such deficiency was to be expected.

Similarly in American nitrogen-balance experiments with growing lambs (Ref. 25), no difference could be detected between the supplementary effects of soya cake, linseed cake and maize gluten meal when added to a basal ration of timothy hay and maize meal.

"Amides" as Protein Substitutes.

Much evidence has been accumulated in the past indicating the possibility that ruminants can to some extent utilise the free "amides" of foodstuffs to meet their requirements for nitrogenous food. In some cases evidence has been adduced that even simpler nitrogenous compounds such as urea or ammonia can be thus utilized. Non-ruminants, on the other hand, have no such powers, and must have the whole of their nitrogenous requirements supplied in the form of true proteins in their food. The explanation of this difference apparently lies in the vigorous bacterial fermentation that takes place in the rumen (paunch), in the course of which bacteria build up the "amides" into protein, which is then placed at the disposal of the animal.

The protein-replacing value of the "amides" of different

foods and rations probably varies considerably under the same and under different conditions, so that for practical rationing purposes only a rough guess can be made at this value. In this country it is now usual in assessing the "protein-equivalent" of rations for ruminants to assume that the amides will have one-half the value of true protein, adding this amount to the digestible true protein, and thereby arriving at the "digestible protein equivalent."

In the section dealing with grassland produce, mention was made of evidence that the "amides" of young grass probably have a higher "protein replacement" value than is here assumed. Similar evidence from a very different diet is also furnished by German experiments (Ref. 26). In the first experiment a full-grown wether was kept in good condition and health for seven months on a diet of straw, starch, molasses and a little yeast, containing barely 7 per cent. of digestible nitrogenous matter, of which only 1·4 per cent. was true protein. The sheep actually stored a little nitrogen, increased slightly in weight and produced wool of good quality. The blood composition was normal and remained constant within the usual limits.

These observations were confirmed in a second series of tests with the same diet. One sheep was maintained on the ration for a whole year, two others for six months, and three young sheep for three months. Increments of flesh, fat and wool were quite normal, and practically equal to those obtained with a ration of clover hay and crushed oats. The results thus point to a very considerable synthesis of protein from the "amides" of the molasses. Incidentally also, the data obtained in these experiments suggest that the digestibility of the true protein of straw is much higher than is commonly assumed (see also later, p. 377).

In another German experiment with sheep (Ref. 27) similar evidence was obtained of the possibility of using glycocoll, urea or ammonium acetate in part replacement of protein.

Before leaving this subject mention should be made that Morris (Ref. 28), in a critical review with special reference to the requirements for lactation, expresses himself as unconvinced of the validity of the existing evidence for the protein-replacing capacity of individual "amides" and simpler nitrogenous compounds. Many of the experiments are certainly open to criticism, but some results are difficult to explain on any other hypothesis.

Protein Requirements.

The importance of reliable knowledge as to the protein requirements of live stock is obvious, especially in times of rising food prices, since protein is always more expensive to supply

than carbohydrates, and waste must therefore be avoided. The importance of the bodily functions that can only be sustained by the supply of protein makes it equally necessary, however, that in the effort to secure economy no serious shortage of protein supply shall be created.

There is much evidence, similar to that in the preceding section, that, when constrained thereto, the animal can make good for considerable periods with surprisingly small supplies of protein. This evidence is, however, as yet too slender to warrant its application to farm practice under normal conditions. Moreover, the farmer is ordinarily less concerned to work on the absolute minimum than on the optimum supply that will give him the widest margin between cost and return. With regard to this practical optimum, which is expressed in the commonly-used feeding standards, the accumulation of more precise knowledge has tended generally to reduce rather than to raise the old standards. This has notably been the case in connection with the protein standards for growth and fattening. Recent tendencies are illustrated by the contributions selected for review here.

Milk Production.

For the most recent review of the subject of the protein requirements for lactation, reference should be made to the article by Morris (Ref. 28) already mentioned above. His general conclusions after reviewing the evidence both as to quantity and quality of protein may be quoted here. "With any mixed ration such as is commonly fed in dairy practice, 0·6 lb. of digestible crude protein or 0·5 lb. digestible true protein per 1,000 lb. live weight is required for maintenance. For maximum milk production the same quantity is required per 10 lb. milk, but, if most of the protein in the production ration be supplied in the form of spring grass, silage from summer grass, low temperature dried blood meal, pea meal or other proteins of high biological value, which supply all the essental amino-acids in the proper proportions for milk production, the amount required is less, and does not exceed 0·44 lb. digestible crude protein per 10 lb. of milk. This means a reduction in production protein requirement of about one-third. It is uncertain whether any part of the protein can be replaced by non-protein nitrogen."

Growing and Fattening Pigs.

In the case of the pig the information required for practical purposes is the lowest amount of protein that will ensure quick live weight gain combined with an optimum balance of lean to fat in the carcase. According to Danish metabolism experiments (Ref. 29) the mere maintenance requirement for protein amounts to no more than 16 grams (0·04 lb.) at 10 kg. (22 lb.) live weight,

rising to 52 gm. (0·12 lb.) at 100 kg. (220 lb.) live weight. If more protein be fed a proportion of this is stored in the body as protein (lean,) a further proportion as fat, and the rest broken up and excreted. As the amount of this extra protein supply is raised, however, the proportion of it that can be stored as protein reaches a limit, varying with the age and growth-capacity of the pig, and any further increase of protein supply can at best produce a little more fat and is largely wasted. At each stage of growth, therefore, there is a minimum supply of protein that will ensure maximum storage of protein (lean) at that stage. In the Danish experiments the maximal storage of protein per day in the body amounted to 90 gm. (0·20 lb.) at 20 kg. (44 lb.) live weight, rising to 120 gm. (0·27 lb.) at 100 kg. (220 lb.) live weight; in other words, the maximal daily gain of protein *per* 100 *kg. live weight* fell from 450 gm. at the lower to 120 gm. at the higher live weight. Assuming 65 per cent. utilization of the digestible protein of the food for growth, the foregoing data lead to the following estimates for the daily requirement of digestible protein for maintenance and maximal growth (cf., also *Guide* for 1934; *Jour.*, Vol. 96, p. 321):—

Live Weight. kg. = (lb.)		Digestible Protein. kg. = (lb.)	
20	(44)	·158	(·348)
40	(88)	·228	(·502)
60	(132)	·253	(·557)
80	(176)	·247	(·543)
100	(220)	·237	(·521)

On this scale the daily weight of protein required reaches a maximum at about 130 lb. live weight, and then falls very gradually at higher weights owing to the increasing extent to which the further increments of live weight consist of fat. In order to comply with these standards the food of a pig weighing about 40 lb. and consuming 2 lb. of food (expressed as meal) daily should contain about 17½ per cent. of digestible protein (or about 23 per cent. total protein), whereas at 220 lb. live weight its capacity for utilizing protein effectively can be satisfied either by 6 lb. daily of a ration containing about 8¾ per cent. of digestible protein (or 11½ per cent. total protein), or by 7 lb. of a ration containing 7½ per cent. digestible protein (10 per cent. total protein).

These standards apply, however, only to optimum conditions under which good pigs are exercising their full capacity for growth. In proportion as the performance of any lot of pigs falls below this growth standard so will fall the amount of food protein that can be effectively utilized.

Feeding experiments at Harper Adams College that have been previously noted in these annual reviews have given substantial confirmation to the foregoing Danish protein-supply

standards as representing the maximum protein supply that can be justified in terms of either rate of growth or quality of carcase. Further confirmation has also been given in more elaborate and precise feeding tests carried out at Cambridge (Ref. 30). In these tests three different levels of protein supply were compared by individual feeding and by group feeding methods. The concentrations of protein in the rations fed to each Lot are indicated below :—

	Percentage of Protein.		
	Up to 90 lb. L. W.	90–150 lb. L. W.	Over 150 lb. L. W.
	%	%	%
High Protein Lot .	26·8	22·1	17·5
Medium Protein Lot .	25·2	20·6	15·9
Low Protein Lot .	21·7	16·9	12·3

The supply of protein to the "Low Protein" Lot accords roughly with the Danish standards given above.

The foodstuffs used were the same for each Lot, the protein concentrates used being white fish meal, meat meal and extracted soya meal. The proportions of these concentrates included in the starting rations of the Lots as set out above were 32 per cent., 22 per cent. and 12 per cent., and in the final rations 25 per cent., 15 per cent. and 5 per cent. respectively.

For details of the varied observations made reference must be made to the original paper, and it must suffice here to indicate that in all respects, whether with relation to rate of growth, efficiency of food utilization, or influence upon type and quality of carcase, the "low" protein dietary proved fully equal to the more liberal protein supplies.

With characteristic caution the Cambridge report stresses that the findings of the investigation "are, strictly speaking, referable only to the particular strain of Large Whites used, and possibly only to animals of this strain in so far as they subsist on rations made up from the foods used in the present feeding treatments."

Further evidence of the adequacy of a relatively moderate protein supply for the economic production of the high-quality baconer is also afforded by the results of nine trials carried out at three Scottish centres on behalf of the Scottish Advisory Committee on Pork and Bacon Production (Ref. 54). Throughout these trials no advantage was found in increasing the protein supply beyond that provided by a ration of 4 parts sharps, 3 parts barley, 2 parts maize and 1 part fish meal for the first stage, and of 3, 3½, 3, ½ parts, respectively, for the last stage of the feeding period. The total protein content of these rations would be about 16½ and 13½ per cent. respectively.

That the broad findings as to the ineffectiveness of high protein supply in enhancing growth rate and carcase quality are applicable over a wide variety of pigs and rations can hardly now be doubted in view of Harper Adams, Cambridge, Scottish and Danish experience.

There would thus now appear to be quite adequate warrant for the advice to practical pig feeders that there is no advantage to be gained by introducing more protein into rations than corresponds to a level of about 17–20 per cent. for the weaner, reduced gradually to about 12 per cent. for the 200 lb. baconer. A typical weaner ration complying roughly with this standard can be made from 4 parts by weight of ground cereals, 3 parts weatings, and 1 part protein concentrate (50 per cent. protein); and from this starting point the proportion of ground cereals may be gradually increased until, for the final stages of fattening, a mixture of 15–20 parts cereals, 3 parts weatings and 1 part protein concentrate is reached.

Before leaving the Cambridge report a number of other observations arising from it, though not relevant to the protein problem, may be noted. Individually-fed pigs did rather better than group-fed pigs, requiring 4–9 days less to reach 200 lb. live weight, and using 7 per cent. less food. Gilts gave a slightly better growth rate, slightly more efficient food conversion, and somewhat leaner carcases than hogs. They graded rather better, and had a tendency to produce a slightly longer carcase and heavier fillet.

Sheep.

Pure wool fibre consists almost entirely of protein, so that the sheep must have a certain level of protein supply if it is to exercise to the full its capacity for producing wool. This is strikingly illustrated by Australian data quoted by Marston in an address at the Grassland Congress. Change from a basal level of 60 gm. protein per day in a maintenance ration to 120 gm. gave an increase of 58 per cent. in the amount of wool grown by a high-producing merino sheep. Increase to 180 gm. protein caused an increase of 95 per cent. in wool growth, and further increase to about 300 gm. protein per day led to an increase of 145 per cent. in the amount of wool grown. These increases were accompanied by an increase in the thickness of the fibre of the wool, changing its spinning quality from the relatively fine to the strong class.

Poultry.

In the *Guide* for 1933 (*Jour.*, Vol. 95, p. 302) reference was made to poultry feeding experiments in Northern Ireland in which high production by laying pullets had been sustained on rations containing less protein than is commonly recommended. The

opinion was expressed that further experiments with different breeds and under a variety of conditions should be carried out "before any drastic change in existing practice is advocated." The further experiments along the same lines that have now been carried out in different parts of the country have justified this note of caution since, although in the main the Irish experience has been confirmed, exceptions have been recorded which require further examination. Other experiments are still in progress, so that a review of the whole subject must be deferred.

One investigation may be noted since it deals with the point (on which the field experiments cannot give information) as to whether the satisfactory egg production on these relatively low-protein diets may not be effected at some cost to the protein reserves of the bird's body. This has been examined by a nitrogen balance experiment at the National Institute of Poultry Husbandry (Ref. 31), in which a complete record of intake and outgo of protein was obtained with two Rhode Island Red pullets kept in cages on rations similar to those used in the field experiments. The level of egg production in each case was excellent. One bird, over a period of 28 weeks, consumed, on the average, 130 gm. per day of mash and grain containing 15·8 gm. of protein (12·15 per cent.), and over the whole period lost from her body only 3·25 gm. of nitrogen (or 20·3 gm. protein). The other bird, over a period of 13 weeks, consumed an average per day of 153 gm. of food containing 18·3 gm. of protein (11·96 per cent.), and over the whole period showed a body gain of nitrogen of 20·5 gm. (or 128 gm. protein). In live weight the first bird gained 57 gm. and the second 56 gm. In these two individual cases, therefore, the protein needs for egg production were clearly covered by the protein supplied in the food, although this was only 75–80 per cent. of the amount laid down in the commonly used standards drawn up by Halnan.

In the case of both birds the nitrogen consumption and the nitrogen balance fluctuated considerably from week to week, the two being closely correlated. In weeks of good food consumption the bird usually stored a little protein, whilst in weeks of poor consumption the nitrogen balance was usually on the negative side. There was no apparent correlation between the nitrogen balance and the intensity of egg production, nor was there any evidence of any better utilization of food protein in periods of high egg production than in periods of relatively low production.

These conclusions are in general accord with the earlier observations of Wilcox (*Guide* for 1934; *Jour.*, Vol. 96, p. 304), recently further confirmed by him (Ref. 32). He adds the further observation that the daily variations in nitrogen consumption and retention do not appear to be correlated with the

loss of nitrogen in feathers during moulting. His data indicate further that birds lay and moult only when their body-weight is increasing, and that such birds tend to make increasing use of their food nitrogen despite a tendency towards decrease of intake.

One notes with regret that it was apparently found necessary to seek publication in foreign journals for these two interesting English poultry investigations.

IV.—General Food Requirements (Energy Supply).

Apart from certain specific requirements such as those for protein, vitamins, etc., which can only be met by the supply of these particular classes of ingredients in the food, the general nutritive value of foods and rations is measurable by the supply of utilizable energy that the animal can derive from them. Of the total energy that can be derived from the digestible portion of the food (the metabolizable energy), some part, varying with different foods, is required to provide for the work of digestion, leaving only the balance (the *net energy*) available for productive purposes and the material needs of maintenance. In studying the results of investigations of the utilization of energy by animals it is thus clearly necessary to keep in mind this distinction between metabolizable (or total digestible) energy and net energy. The latter rather than the former represents the measure of practical food values.

Properly applied, the conception of food as a source of energy has been of immense value in the study of animal nutrition problems and has furnished the main basis upon which the science of nutrition rests. Some of the energy studies published during the past year are touched upon below, including some investigations which are in essence energy studies although the data may not be expressed in energy units.

Nutrition of Dairy Cattle.

Reference has been made earlier to the review by Morris (Ref. 28) of the present stage of knowledge concerning the relation of protein supply to milk production. For a review of recent progress over the whole field of the nutrition of dairy cattle, a further article by the same author (Ref. 33) should be consulted. Only a few items from the literature of the past year can be dealt with here.

From the recorded yields of milk and milk fat of 2,400 cows tested at the London Dairy Show between 1922 and 1934, Edwards (Ref. 34) has calculated the " gross efficiency " of milk production (*i.e.*, the ratio of energy in milk produced to energy in the digestible nutrients consumed). Amongst the best cows of the various breeds he found little difference in gross efficiency, the value ranging from 36·75 to 42·5 per cent. for cows, and

from 35·0 to 39·75 per cent. for heifers milked thrice daily. Cows, in spite of their greater weight, are thus, on an average, more efficient than heifers. The values were lower for cows and heifers milked twice daily. Within a breed the gross efficiency tended to decrease slightly with increase in live weight. Live weight increased with increase of milk yield, but at a much slower rate. There was a steady increase in gross efficiency in Dairy Shorthorns from 32·5 per cent. for cows yielding about 35 lb. of milk daily to 41·5 per cent. for those yielding about 75 lb. Similar increases were noted in other breeds. In a study of 1,176 Register of Merit records of the English Jersey Cattle Club, the gross efficiency was found to decrease steadily from 38·75 per cent. in the first month after calving to 29·25 per cent. in the tenth month.

In similar American studies (Ref. 35) it was also found that Jersey and Holstein cows produced their milk at practically the same gross efficiency level, namely, 34 per cent. This compared with 30 per cent. for average cows of the Station herd, and 43·5 per cent. for an outstanding Holstein cow. In these studies no correlation could be traced between gross energy efficiency and live weight.

Sheep Feeding Standards.

Sheep feeding experiments at Oxford (see *Jour.*, Vol. 94, p. 307) have raised the question as to whether the feeding standards formulated by Wood in 1928 (see Ministry of Agriculture *Bull.* No. 48, 9th ed., p. 36) are not too high with regard to the level of dry matter consumption required. Whereas Wood's standard requires the 100 lb. sheep to consume 3·4 lb. per day of dry matter, Watson was obliged to conclude from the Oxford data that with the ordinary type of winter feeding practised in this country the daily dry matter consumption of sheep is unlikely to exceed 2·6–2·7 lb. per 100 lb. live weight (or 75–80 per cent. of Wood's standard), and that this level can only be maintained if from one-third to one-half of the dry matter is given as air-dry foods (hay, meals, etc.). With heavy root feeding or on low protein rations the consumption of dry matter may be still lower.

A further report from Oxford (Ref. 35) on more recent experiments now confirms these results and carries the argument a stage further. This report summarizes the results of six further feeding trials, in which the food supply to the different Lots ranged from an estimated starch equivalent per head per week of 6·55 lb. to 13·51 lb. (0·93–1·93 lb. per day). The average live weight increases per week recorded ranged from 0·66 lb. to 3·27 lb. As the food supply was increased the ratio of *additional* starch equivalent consumed to *additional* live weight gain produced remained relatively steady at an average of 4·4 to 1 (or

practically identical with the 4 : 1 ratio for the conversion of pure starch into body fat). The deduction may thus be drawn that a sheep, supposing that its energy requirements for maintenance, body-growth, and wool production are already met, requires about 4½ lb. of starch equivalent for each pound of additional gain, and that this figure remains much the same as the level of nutrition is raised.

That Wood's standard of 9 lb. starch equivalent per 100 lb. live weight per week for the maintenance energy-requirement of the sheep is too high is indicated by the fact that in seven lots of sheep in the Oxford experiments average live weight increases of 0·66 lb. to 1·77 lb. were obtained, although the estimated starch equivalent consumed per 100 lb. live weight was in no instance over 9·2 lb., and in one case was as low as 6·9 lb. Watson concludes from these data that, "at a rough guess," 6½ or 7 lb. of starch equivalent per 100 lb. live weight per week provided not only for maintenance but for normal growth, and 9 lb. per week provided, in addition, for the storage of fully half-a-pound of fat.

He suggests further that in the formulation of standards for growing animals the requirements for growth should be incorporated with the maintenance figure rather than with the production figure as is customary. On this basis and from the Oxford data the following standards are suggested for the fattening teg, 9 to 12 months old :—

Per 100 lb. Live Weight.	Starch Equivalent per week.
Maintenance *plus* normal growth (¾ lb. live weight weekly)	6—7 lb.
Fat-production, per lb. *additional* live weight gain . .	4—4½ lb.

So far as concerns the appetite (in terms of dry matter) of the sheep on winter dietary, the issue would now appear to be practically settled in favour of a close approximation to the Oxford standard by the results of new Cambridge experiments (Ref. 36), in which food consumption on a variety of diets was determined. As was to be expected, the variations of consumption from day to day on every diet were considerable for each individual sheep, but the tabulated averages show that at all live weights the average daily consumption of dry matter on winter diets was almost invariably well below Wood's standards, the extreme individual values ranging from 69 to 108 per cent. of the "standard" appetites, with an average of 86·0 per cent. Oxford and Cambridge agree substantially, therefore, so far as winter feeding is concerned, in reducing Wood's standards for "appetite" by about 15 per cent. (Cambridge) or 20–25 per cent. (Oxford).

On the issue as to the maintenance requirement of the sheep, however, the Cambridge workers, after re-examination of the

evidence available, decide in favour of Wood's standard, so that on this point the "battle of the blues" is still joined.

In a second series of experiments at Cambridge (Ref. 36) the amounts of grass consumed by sheep on grass pasturage of varying quality were determined. In the early part of the 1934 season, with herbage excellent in quality and digestibility, the amounts of dry matter consumed by the sheep were found to be from 4 to 17 per cent. *in excess* of Wood's standard (unrevised). Later in the season (June), with less palatable and nutritious herbage, the consumption was rather less, but still little short of the Wood standards. Similar results were obtained in the following year. Thus even at the worst the sheep took appreciably more dry matter when grazing than when on winter diets. This is doubtless a matter of superior palatability.

V.—Vitamins.

The spate of literature dealing with vitamin research continues unabated and does not permit of concise review. A few items of direct agricultural interest will serve, along with those quoted in earlier sections, to illustrate some of the problems under examination.

Vitamin A.

The transmissibility of vitamin A, and of the carotene from which it originates, from food to milk may now be accepted as having been adequately demonstrated. A recent report (Ref. 37) now carries the matter a stage further by recording experience with cows of different breeds and at all stages of lactation. The results show that individual variations among cows of the same breed are large, but that, apart from abnormally high values at the colostral stage, the carotene and vitamin A values of the butter-fats are far more dependent upon diet than on stage of lactation. The average values for the year, and for the "winter" period (October–March) and "summer" period (April–September), along with the minimum and maximum values recorded, are summarized below, all the values being expressed in milligrams per 100 gm. of fat (or parts per 100,000) :—

Breed.	Gross Average.	Winter Average.	Summer Average.	Minimum.	Maximum.	Ratio of Vitamin A to Carotene.
Carotene—						
Shorthorn	0·27	0·25	0·29	0·09	0·54	
Ayrshire	0·36	0·27	0·41	0·11	0·69	
Friesian	0·40	0·35	0·47	0·11	0·85	
Guernsey	0·92	0·73	1·14	0·42	1·97	
Vitamin A—						
Shorthorn	0·68	0·58	0·84	0·36	1·24	2·5 : 1
Ayrshire	0·85	0·66	1·18	0·30	1·42	2·4 : 1
Friesian	0·90	0·61	1·21	0·52	1·50	2·25 : 1
Guernsey	0·75	0·54	0·95	0·37	1·42	0·80 : 1

The Shorthorn values are lower than were found in previous work, and further tests with larger groups gave average values of 0·50 for carotene and 1·01 for vitamin A.

In trying to assess the combined values of carotene and vitamin A, account must be taken of the fact that the vitamin is several times more effective biologically than the carotene. This reduces the apparent superiority of the butter fat from the Guernsey milk, but still leaves it a little ahead of the fats from the other three breeds, between which there is no significant difference.

Another report (Ref. 38) deals with similar studies of the transmissibility of vitamin A from the food of the hen to her eggs. By the addition of 10 per cent. of codliver oil to a diet poor in vitamin A and carotene, the vitamin A content of the eggs was doubled. By the intensive use of a concentrated preparation of vitamin A it was found possible to raise the concentration of the vitamin in the egg to about five times the level found on the basal diet alone. In spite of these considerable increases, obtained at a level of supply which apparently exceeded the limits of absorption by the intestine, the proportion of the vitamin consumed that reached the eggs amounted to only 2 per cent. for the codliver oil and 0·2 per cent. for the concentrate feeding. Post-mortem examination of the experimental birds revealed a relatively high concentration of vitamin A in the livers, a much lower, but still considerable, storage in the kidneys, but no more than negligible traces in the other organs examined. The storage role of the liver in the vitamin A economy of the bird thus appears to be essentially the same as it is known to be in the mammal.

Vitamin D.

A characteristic of the developing study of vitamins is the discovery in nearly all cases that what was originally regarded as a single vitamin proves to be a complex of individual vitamins similar in general character but differing in the detail of their activities. This point is of particular interest and importance in the case of vitamin D in view of the extent to which deficiencies of this vitamin arise as practical problems on the farm. Until recently equal value, if not actual identity, has been assumed for the vitamin D in codliver oil and irradiated ergosterol, the two forms in which vitamin D is commonly administered. The vitamin D values of codliver and other oils are therefore usually determined by comparison with irradiated ergosterol used as standard and with the rat as the test animal. The relative values thus arrived at seem to accord satisfactorily with actual experience in the use of the materials in human nutrition, but have been found to be unreliable in their application to the feeding of chickens. A particular dose of vitamin D as measured by the

rat test is more effective with chickens when given in the form of codliver oil than if given as irradiated ergosterol (or similar "vitamin D concentrate"). The question is clearly one of considerable importance to the poultry keeper, and to those concerned with the provision of the warranties as to vitamin D content on which his purchases and use of codliver oil are based. In a recent review of this aspect of the question (Ref. 39) the conclusion is drawn that "sources of vitamin D for use with poultry should be standardized by means of tests with chickens only, and the standard material used for comparison should certainly not be irradiated ergosterol."

Whether similar discrepancies arise in the application of the rat data to the feeding of pigs, calves and dairy cows cannot as yet be stated.

Another report (Ref. 40) dealing with an experiment carried out at the National Institute for Research in Dairying throws light on the question as to the source of the additional vitamin D found in summer milk as compared with winter milk. This is commonly regarded as a direct transfer of the vitamin from the grass to the milk, but the Reading observations suggest that the extra vitamin comes not from the herbage, but from the direct exposure of the cow to sunshine and sky-shine.

Two cows, kept indoors during May and June on a winter ration including silage (vetch and oat) and seeds hay, produced milk containing on the average 8·3 international units (I.U.) of vitamin D per 1 kg. of milk, whereas the milk of two other cows similarly fed, but kept outdoors, gave an average of 26·0 I.U. In another comparison two cows fed on a summer ration *plus* cut fresh grass, and kept indoors, gave an average of 5·3 I.U., whereas two other cows receiving the same summer ration outdoors on pasture gave an average of 17·0 I.U. of vitamin D per 1 kg. of milk.

It is interesting to note that the winter ration proved to be a better souce of vitamin D than the summer ration. This is attributed to the hay, which is known to acquire some anti-rachitic properties (presumably vitamin D) in the process of curing. The results with the summer ration *plus* grass seem to demonstrate clearly the inefficiency of fresh grass in itself as a source of vitamin D for the cow.

VI.—Digestibility.

The importance of accurate knowledge as to that part of the food which becomes available to the animal through the processes of digestion ensures that problems relating to digestibility are continuously under investigation. A selection of recent reports is reviewed below under the headings of the class of animal with which the experiments were carried out.

Ruminants.

The Rumen.—The essential difference between the ruminant and non-ruminant animal lies in the capacious rumen or paunch with which the former is provided. That its function is not merely that of providing temporary storage accommodation for the food pending its re-transference to the mouth and complete mastication can be stated with certainty, but despite a great deal of research there still remains a good deal of uncertainty as to the further part it plays in ruminant digestion. A survey of recent work on this subject is included in Morris' review (Ref. 33), where the appropriate references will be found to the original reports from which the following extracts are taken.

Columbus (Berlin, 1934), in a detailed study of the process of evacuation of the rumen in sheep and goats, found that the test meal was uniformly distributed in the rumen within two hours of feeding. The major portion of the meal left the rumen in 24 hours, and completely in 8–12 days. Undigested matters from the test meal began to appear in the fæces within 12–15 hours, and reached a maximum at two days. A period of 15–20 days was required for complete excretion. The rate of passage of the food was accelerated by green food. With no roughage in the diet the emptying time of the rumen was delayed to 17–20 days, and complete excretion to 22–23 days. With lambs, milk passed straight into the abomasum ("fourth stomach") and excretion reached a maximum in 24 hours.

Experiments with liquids have given variable results, the liquid in some cases having passed straight to the abomasum, whilst in others it passed first into the rumen. There is evidence that in the former case some part of the fluid may pass back into the rumen.

With fibrous foods, such as straw or hay, there is a primary digestion in the rumen before the food is passed forward. According to American observations, the protein tends to leave the rumen more quickly than the fibre, so that the rumen contents tend to become more fibrous. The percentage of protein, however, will not necessarily fall, as the removal of protein will be offset by loss of carbohydrates through fermentation by bacteria, possibly aided by protozoa.

Protein Digestion.

In other American tests the presence of roughage did not appear to influence the digestibility of the rest of the ration, but Canadian experiments (Ref. 41) suggest that the size of the ration may affect the digestibility of the protein. In comparisons of the digestibility of a ration of equal parts hay and barley, fed to steers at levels ranging from 2·2 lb. to 11·0 lb. of each constituent per head per day, the apparent digestibility of the protein

was definitely lowered as the plane of nutrition rose. A similar, but smaller, effect was also exercised on the digestibility of the "carbohydrates."

These effects may arise, however, more from the defects of the method of experiment by which digestibility is measured than from any real falling-off in the digestibility of the food. This applies especially to the data for protein and oil.

In the "digestion trial" it is assumed that all the organic matters in the fæces come from the food, and represent the undigested portions of the food. So far as the nitrogenous matter of the fæces is concerned, however, this comprises, along with the undigested nitrogenous matters from the food, certain other nitrogenous matter coming from the animal itself ("metabolic nitrogen"). This latter consists of a constant fraction voided when the animal is fasting, and a variable fraction dependent on the amount of both total dry matter and of indigestible dry matter in the diet. The higher these two items, and especially the latter, the greater will be the amount of metabolic nitrogen voided, the richer in nitrogen will be the fæces, and therefore the lower the result for the apparent digestibility of the nitrogenous matter (crude protein) of the food—since this is arrived at by deducting total nitrogen voided from total nitrogen consumed.

Owing to this complication the results obtained for the apparent digestibility of protein in foods very poor in protein, such as straw, are very inaccurate and misleading as indications of the real digestibility of the protein. In recent experiments at the Hannah Dairy Research Institute (Ref. 42), for example, the protein of straw which showed an apparent digestibility of 30 per cent., proved after correction for the metabolic nitrogen present in the fæces to have a true digestibility of 100 per cent.

In these experiments with goats, sheep and cows the metabolic nitrogen excretion on a normal diet averaged about 0·45 gm. per 100 gm. of dry matter intake.

In further experiments at the same centre it was found that the fæcal nitrogen excretion, and therefore the apparent digestibility of a protein, varied according to the requirements of the animal, and also according to the biological value of the protein ingested. The higher the biological value of a protein the lower is the apparent digestibility. Similarly, the greater the requirement of the animal for protein the higher is the digestibility.

Pigs.

Meat Meals.—Data for the digestibility by pigs of three meat meals of widely differing fat content, made from the same raw material, have been obtained in tests at Cambridge (Ref. 43).

The "high fat" meal was obtained by digestion of the raw material at 245°F. in a steam-jacketed melter and draining off the molten fat. From this material the "medium fat" material, representing the ordinary trade product, was then prepared by passing through an expeller press to remove further fat. From this grade the "low fat" meal was then made by dissolving out the bulk of the remaining fat by extraction at 300°F. with petroleum benzine. On the basis of dry matter the three meals contained 66·4, 71·6 and 71·7 per cent. crude protein, and 18·8, 11·1 and 3·2 per cent. of fat respectively. Digestibility was relatively high in each case, the coefficients for the organic matter being 88·3, 93·1 and 83·9 per cent. respectively. The advantage here indicated in favour of the "medium fat" meal was shown also in the digestibility of the protein. In the case of the fat the digestibility fell as the amount of fat in the meal decreased, the coefficients being 95·4, 89·0 and 82·3 per cent. respectively. Taking all ingredients into account, the "medium fat" meal was thus the most digestible, and the "low fat" meal the least digestible of the three samples. For certain purposes, however, such as the feeding of pigs for bacon, the advantage of higher digestibility in the case of the former may be more than offset by greater risk of lowering the quality of the carcase fat (see next section). Palatability also is a factor that cannot be ignored in the case of meat meals, being often so low as to lead to unsatisfactory consumption (Ref. 51).

Poultry.

Wheat Offals.—Data on the digestibility by poultry of broad bran, straight-run middlings and fine middlings are available from trials at Cambridge (Ref. 44).

Bran showed a low digestibility for all constituents, especially fibre (9·2 per cent.). The organic matter as a whole was only 39 per cent. digestible, as against figures of the order of 65–75 per cent. obtainable with pigs and ruminants. As a source of nutriment for poultry bran must clearly be regarded as relatively dear, and its inclusion in chick-feeding mixtures can be justified only on dietetic grounds. This justification is given by the improved appetite, and consequent improved growth, of the chicks on the mixtures containing bran.

The "straight-run pollards" used contained 6·1 per cent. of fibre and the organic matter showed the fairly satisfactory digestion coefficient of 63 per cent., despite, again, a very low fibre digestibility (5·4 per cent.).

The "fine middlings" used contained only 1·9 per cent. of fibre and thus constituted practically a flour. This is evident also in its low content of protein (8·4 per cent.). The digestibility of the organic matter of this product was naturally high (84·6

per cent.) and comparable with the level attainable with other low-fibre foods. Middlings of this fineness are apt to give trouble by clogging the beaks of the birds, and for this reason it is advised that they should not form more than 40 per cent. of the total mash.

In chick rearing experiments with which the digestibility trials were supplemented, a mixture of bran and weatings appeared to form a biologically better balanced food than either separately.

Dried Molassed Sugar-beet Pulp.—In view of the excellent digestibility results for this feeding-stuff obtained with pigs, the results of trials at Cambridge (Ref. 44) with poultry are very surprising and disappointing. The organic matter proved to be only 17·5 per cent. digestible on the average of four birds. Even the nitrogen-free extract (" carbohydrates "), which must have included a proportion of sugar, was only 22·1 per cent. digestible. The digestibility of the 13·6 per cent. of fibre in the pulp was so low that it could not be measured. As the results were obtained by a difference method it is probable that they under-estimate somewhat the true digestibility, but should they be confirmed by further tests it is very unlikely that the hen will become a serious competitor with the ruminant for this feeding-stuff.

Huskless Oats.—Data for the digestibility of the ordinary oat are obviously not applicable to huskless oats owing to the presence of a large proportion of husk in the former as consumed by live stock. The interest recently aroused in the growing of huskless oats has led, therefore, to digestion trials, the results of which are given in a report from Armstrong College (Ref. 45). In these trials the digestibility by poultry of Victory oats and huskless oats was determined, with the average results summarized below :—

PERCENTAGE DIGESTIBILITY.

	Victory.	Huskless.
Total Organic Matter	69·8	86·2
Crude Protein	77·4	82·2
Ether Extract (" Oil ")	83·5	62·4
Fibre	8·8	—
N-free Extract (" Carbohydrates ")	76·8	90·8

The high figure for the organic matter of the huskless oat puts it in the highest order of digestibility. This is confirmed further by the high coefficient for crude protein, but it is not obvious why the oil of the huskless oat should have proved so much less digestible than that of the Victory oat. The calculated starch equivalents of the two oats as used were 58·1 per cent. for Victory and 70·2 per cent. for the huskless oat, which implies roughly a 20 per cent. superiority of the latter for general production purposes when used in a properly balanced ration. The

mineral content (2·0 per cent.) of the huskless oat was appreciably lower than that of the Victory oat (4·0 per cent.), but the difference is probably mainly attributable to the relatively valueless minerals of the husk of the latter, which are not represented in the former.

Whole v. *Ground Grain.*—In Russian experiments on this question (Ref. 46), using a mixture of three parts oats with four parts wheat, no improvement of percentage digestibility was effected by grinding the grain, apart from an apparent slight increase in the digestibility of the oil; but the meal was digested at an appreciably faster rate than the whole grain. The use of a proportion of meal in the ration thus enables the bird to obtain in a definite period more nutritive material than if grain alone be fed. The optimum proportion will probably vary under different conditions of production and at different seasons of the year.

VII.—Fat Problems.

The study of the factors that determine the quality of the fat in the carcase of the meat-producing animal has been steadily gaining in importance in recent years and must now rank as one of the major problems of animal husbandry. The main features of the problem, in so far as it is associated with nutrition, have been outlined in previous reviews, and it will suffice here to recall that interest largely centres upon the oil supply in the food, which by its quantity and character may have a determinative influence upon the quality of the carcase fat. The bulk of the latter will normally be produced from the carbohydrates of the food, and in so far as it is so produced will tend to be normal in character for the class of animal consuming the food. That part of the body-fat which comes from the oil of the food, however, will tend to vary with the character of the food oil, and especially with its content of olein and similar ingredients which derive from oleic and other unsaturated acids. These ingredients tend to produce a soft fat and therefore are particularly liable to create difficulties in the production of those forms of fatty produce, such as pork, bacon and butter, in which the fat is, at best, somewhat soft in character. It is not surprising, therefore, that a great part of the work on the subject has been concerned with these particular products. A few examples from the past year's literature may be noted here.

A Canadian report (Ref. 47) summarizes the results of some studies on the causes of soft bacon. As a criterion of the firmness of the fat the "iodine value" was used, this being a figure based upon the power of the fat to absorb iodine, which power rises with the degree of "unsaturation" (or, roughly, "softness") of the fat, the "value" of bacon fat of normal consistency being usually about 60.

In the first experiment oats (an oily food) and barley were fed in varying proportions, together with separated milk, to different groups of pigs on pasture. No soft fats were produced, although the iodine value increased sligbtly with the proportion of oats fed. In a similar experiment in which wheat replaced barley in the rations, satisfactory firmness was obtained in the carcases. The weight of the pig at slaughter, within the range of 180 to 225 lb., did not seem to have any appreciable influence on the firmness of the fats, nor did variation in the quantity of protein fed.

Some evidence was obtained, however, that low-temperature conditions may be a predisposing cause of softness. Thus the iodine value of 150 samples of fat taken in summer was 58·2, while that of 72 samples in winter was 62. (Similar differences are also shown by unpublished data from the Harper Adams experiments, in which, with widely varying fat-contents in the rations, the average iodine value of 305 samples taken in the warmer months was 59·2, and for 246 samples in the colder months 62·9.)

Figures are also given showing a correlation between rate of live weight gain and softness of fat. Pigs with a daily live weight gain of less than 1 lb. tended to produce a higher proportion of soft carcases than those which grew at a faster rate. There was also some evidence in the iodine values of pigs from different litters that firmness of fat might be an inherent characteristic; which suggests that selective breeding for firmness of fat should be a feature of a systematic breeding policy.

Supplementary to these Canadian observations, mention may be made that the Harper Adams data referred to suggest further that an average iodine value of 60 or less is difficult to attain if the proportion of oil in the ration appreciably exceeds 2 per cent. in winter or 3·0 per cent. in summer. The seasonal difference is doubtless associated with the generally better growth made, and the lower consumption of food (and therefore of oil), in the warmer than in the colder months.

The influence of food oil on bacon fat needs particularly to be kept in mind in connection with the use of codliver oil in pig-feeding. This is clearly brought out in one of the Harper Adams experiments (Ref. 48). An addition of 1 per cent. of codliver oil to the diet had a detrimental effect upon the firmness, colour and curing quality of the carcase fat, even in cases where the use of the oil was discontinued after the pigs reached 100 lb. live weight. In those cases where the codliver oil was given up to the time of slaughter the effect was particularly marked. Where any supplement of vitamin A may be necessary in pig fattening it would seem preferable, therefore, to give this in the form of greenstuff, either fresh or dried.

The influence of rate of growth upon softening effects referred to above seems also to be brought out in experiments at Cambridge (Ref. 49) on the effect of different cereals on the composition of the body fat of the fowl. Previous work at this centre has demonstrated that in the fowl, as in the pig, a close relationship exists between food fat and the body fat made from it. The cereals tested in the later experiment were maize, oats and barley, fed along with dried separated milk. The iodine values of the oils of all these cereals are high (103–113), but whereas barley contains only about 1½ per cent. of oil, oats and maize contain about three times this proportion. The results were in accordance with expectation in showing a softer body fat from the oats and maize than from the barley, the former, however, being of about normal consistency for the fat of the fowl, whereas the fat from the barley feeding was rather firmer than normal. Judged by practical standards, therefore, no objection could be raised to the quality of the fat from either the oats or the maize ration.

The reason for the less potent softening influence of maize in poultry fattening compared with that commonly debited to it in pig fattening doubtless lies in the fact that, in the former case, the fattening period is short, seldom lasting more than 12–18 days, during which time not much fat can be formed from food-oil; whereas in the case of the pig the fattening process extends over many weeks, during which time a much greater fraction of the body fat may be formed from food-oil.

Another factor associated with quality in fat is its colour, this also being associated to some extent with the food. On this point a report from Cambridge (Ref. 50) raises interesting possibilities for further study. The experimental work was carried out with rabbits, but the conclusions may prove to be generally applicable to other classes of animal. The tentative conclusion suggested by these results is that in fattening a portion of the pigment from the food is laid down in the fat, but that when such fat is used for body maintenance the pigment is not wholly reabsorbed, but concentrated in the fatty tissue, thereby deepening the colour. This would explain why the fat in old cows and steers, which have undergone seasonal fluctuations in condition, is usually of a darker tint than that of young cattle which have fattened steadily; it may explain also why animals that have been once fat, and are afterwards killed in poor condition, are usually darker in colour than fat animals.

VIII.—Pig Feeding Experiments.

Restricted Feeding.

Further data are now available on the influence of varying levels of food supply upon growth rates, carcase quality and

economic returns. It may be recalled (see *Jour.*, Vol. 97, p. 312) that tests at Cambridge on individual feeding lines showed a distinct advantage from restricting the allowance of food to pigs, from 65 lb. live weight onwards, to a level about 25 per cent. below the amount they would take if fed *ad lib.* at two feeds daily. The further evidence then reported from group-feeding tests on similar lines was conflicting, but on the whole confirmatory of the Cambridge experience.

Two further tests (Ref. 48) on group-feeding lines at the Harper Adams College have given results favourable to restriction so far as efficiency of utilization of food is concerned, but indecisive as to effect upon grading and financial returns. In the first experiment, carried out in the summer of 1936, 90 Large White pigs were used to get information on the effects of three degrees of restriction of food supply (10, 15 and 20 per cent. below "full-fed") introduced after three points of live weight (65, 85, and 100 lb.). The results were indecisive as between the various degrees of restriction and the points of live weight at which they were introduced; but, taking the restricted groups as a whole, they showed a clear advantage in food economy, back-fat grading and financial returns, the last-named amounting to an average of about 2*s.* 6*d.* per pig over the returns from "full feeding."

In the second experiment, carried out in the following winter, three lots of 20 pigs each (housed in groups of five pigs) were used to test the effect of a 15 per cent. and 20 per cent. reduction of food supply introduced into each sub-group of five pigs after its average weight reached 100 lb. In this case the restriction again enhanced the efficiency of utilization of the food, but there was no significant difference in either grading quality or financial returns. There was also no significant difference between the 15 per cent. and 20 per cent. restrictions. In each experiment the difference as between the restricted and unrestricted pigs, in the time required to dispose of all the pigs at saleable weights, was surpisingly small.

In another restriction experiment, carried out at the Rowett Institute (Ref. 51) two lots of 12 pigs each were fed literally *ad lib.* from dry feeders and compared with two other similar lots rationed on a scale providing for an initial daily allowance of 2 lb. per pig for pigs of about 40 lb. live weight, with an increment of ½ lb. per pig per day each week thereafter, increasing to a maximum daily allowance of 6½ lb. per pig. In this case the controlled rationing proved superior to the *ad lib.* feeding as regards efficiency of food utilization and carcase grading. Of the two types of dry feeder used for the *ad lib.* lots, one was evidently not very efficient, as the pigs on it required 12 days longer than those on the other feeder, and secured only 10 lb. more food per

head. As between the more efficient *ad lib.* feeder and the rationed dry feeding, the average pig in the latter consumed 57 lb. per head less food, but required 21 days longer to give the same live weight gain. The second rationed lot, which was " wet fed," did rather better, consuming 90 lb. per head less food and taking only 12 days longer than the better of the two *ad lib.* lots.

The problem of restriction is obviously more complicated under group-feeding than under individual feeding conditions, and reliable guidance will be possible only when a large mass of comparative data, obtained under varying conditions, has been accumulated.

The following data from four Swedish experiments (Ref. 52) are of interest for comparative purposes.

Group.	Feeding.	Av. Daily Live Weight Gain. gm. (=lb.)	Food Units per 1 kg. L.W. Gain.
A	Standard throughout	613 (1·35)	3·82
B	Standard up to 50 kg. (110 lb.) full-fed thereafter	623 (1·37)	3·92
C	Full-fed throughout	637 (1·40)	4·04
D	Standard to 50 kg. (110 lb.), then 10 per cent. reduction	592 (1·30)	3·74

All groups were fed to an average weight of approximately 200 lb., and the slaughter losses for the different groups were practically the same, 25·3–25·7 per cent. The results are substantially in accord with British experience summarized above.

In a study of recent investigations in Denmark the same author arrives at the following conclusions (Ref. 52) :—(1) A food consumption of 3·34 feed units per kg. live weight gain is a satisfactory average to aim at. (2) Shorter pigs show a slightly higher food consumption than longer pigs, because of being fatter ; an increase in back fat thickness from 3·3 to 4·8 cm. causes an increase in food consumption from 3·40 to 3·47 feed units per kg. live weight gain. (3) Breed and ancestry are of importance in determining food utilization. (4) Intensive fattening is the most economical method from the point of view of food consumption, but too rapid fattening leads to carcases of poor quality. The feeding of bulky foods, such as grass, green foods and potatoes, in the last weeks of fattening is recommended in order to retard the onset of slaughter maturity and thereby improve carcase quality.

Lastly under this heading, although the subject is only in part associated with control of food supply, reference may be made to the valuable studies of Hammond and his colleagues on the bearing of body proportions and the differential growth and fattening characteristics of the various parts of the body upon

the ultimate economic quality of the carcase. Their latest contribution (Ref. 53) is full of matter of great interest.

Influence of Group Size.

There is a common belief in practice that animals tend to do better when housed and fed in small groups rather than in large groups. Doubtless there is some truth in this when a certain size of group is exceeded, but the results of a comparison at the Rowett Institute (Ref. 51) with groups of 4, 6 and 12 pigs suggest that with pigs there is no falling off in efficiency up to the 12-pig group. Probably floor space and adequacy of trough room are more potent factors than the actual size of the group.

Wet and Dry Feeding.

In the Scottish test referred to above under "Restricted Feeding," the restricted wet-fed lot did rather better than the comparable lot that received the same ration dry-fed on the same scale. Both lots proved superior in economy to uncontrolled dry-fed lots.

In a group feeding experiment in Northern Ireland (Ref. 55) with five replications, unrestricted dry feeding was compared with restricted wet feeding, using two rations, one containing ground wheat and the other an equal proportion of pollard. The unrestricted dry feeding resulted in a slightly quicker growth than the damped, restricted feeding, but this was solely because the dry-fed pigs ate more meal. Judged by the amount of meal taken per pound of live weight gain, they were the less economical. Moreover, they did not grade as well as the pigs which received their food damped and restricted in amount. Neither on the dry nor on the wet feeding was any significant difference found between the wheat and pollard rations as to either growth rate, economy of food conversion, or grading returns.

Indoor v. *Outdoor.*

In a German experiment (Ref. 56) with young pigs, one group being confined indoors and the other allowed outdoor exercise, both groups being further sub-divided into milk-fed and non-milk-fed lots, the indoor pigs grew more rapidly than those allowed out. In both cases the feeding of milk at the rate of 1 litre (1·7 pint) per pig per day, along with a mixture of 3 parts barley, 3 oats, 2 rye and 1 fish-meal, proved beneficial. The influence of the milk was greater on the indoor than the outdoor pigs.

Separated Milk.

Favourable experience at Auchincruive in the use of separated milk along with barley meal in the proportion of 1 lb. meal to 1 gall. milk has been confirmed in a further experiment

(Ref. 57). An average daily live weight gain per pig of 1·33 lb. was obtained on an average consumption of 1·33 lb. barley meal plus 1·33 gall. of separated milk for 1 lb. live weight gain. Taking the cost of separated milk at 1*d.* per gall., the financial return from the barley-milk feeding was equal to that from the standard ration. The milk ration, moreover, reduced the feeding period from 150 to 140 days. Grading returns were very satisfactory. The daily allowance of milk rose to 3 gall. per head in the final week, and at this level caused the pens to be very wet. It is recommended, therefore, that a maximum of 2 gall. per day might with advantage be fixed, and that for the final eight weeks of the feeding period the barley meal allowance might be raised, by weekly increments of ¼ lb., to a maximum of 4 lb. per day at the final stage of fattening.

Wheat.

The value of wheat in pig-feeding has been tested at four centres in Scotland under the supervision of the Advisory Committee (Ref. 54). Seven separate trials were carried out, using rations containing varying proportions of coarsely ground wheat. From the results it would appear that the maximum proportion suitable for young weaners is about 30 per cent., but that when the pigs have reached about 120 lb. live weight the proportion may, if desired, be raised to 45 per cent. or possibly higher.

A comparison of wheat with pollard in Northern Ireland has been referred to above (see wet *v.* dry feeding).

Supplementary Feeding of Suckling Pigs.

Experiments at Wye (Ref. 58) have shown marked improvement in growth and health of young suckling pigs from the use of barley water containing iron, between the ages of two and six weeks, as a supplement to the sow's milk supply. Mortality in litters receiving this supplement was much lower, and weaning weights higher, than in control litters. They also suffered less from scour. During autumn and winter it was found advantageous to continue the supplement up to the age of 12 weeks. Most litters started to drink the supplement at 2–4 weeks old.

The supplement is made by stirring barley meal into boiling water at the rate of 1 lb. per gall.; the mixture is allowed to cool and settle, and the cloudy "barley water" then decanted. To this Parrish's food is added at the rate of 1 oz. to a pint of barley water. The mixture is supplied to the pigs in a creep at the rate of one pint to eight pigs, starting when the pigs are two weeks old. Any residue is rejected in the evening and a fresh supply given next morning.

Starch Equivalents.

The scanty data on the starch equivalents of feeding-stuffs for pigs as determined by direct experiment have been augmented by results reported by Fingerling on carrots (Ref. 59) and sugar beet (Ref. 60).

The dry matter of *carrots* was found to be very well digested by the pig and to have a mean starch equivalent of 56·9 per cent. as compared with 61·1 per cent. when consumed by bullocks. The protein of the carrot was rather better digested by the pig than by the bullock.

In the case of *sugar beet* the pigs digested both fresh and dried sugar beet better than oxen, and with neither animal could any significant difference be found between the digestibility or utilization of the two products. With fresh sugar beet the starch equivalent of the dry matter was found to be 72·4 per cent. with pigs and 56·0 per cent. with oxen, the corresponding figures for dried beet being 76·4 and 54·9 per cent. respectively.

IX.—Miscellaneous Products.

Cacao Shell.

In referring to this material in last year's *Guide* (p. 169, *Journal*, p. 319) mention was made of the divergence of evidence as to the digestibility of its protein. Recent determinations were quoted which showed a much higher digestibility than was originally found by Kellner. A more recent German report (Ref. 61) now inclines the balance again towards the lower figures. Trials with four sheep gave figures for digestibility of the crude protein varying between 18 and 36 per cent., whilst the true protein appeared to be quite indigestible. The "carbohydrates" were digested to the extent of 83 per cent. and fibre 34·5 per cent. The starch equivalent of the dry matter (using crude protein in the calculation) was assessed at about 53 per cent., which is considerably higher than previous estimates.

The suitability of cacao shell, up to 2 lb. per head per day, for dairy cows, has been demonstrated in further experiments at Reading (Ref. 62), in which, moreover, evidence was obtained of a specific influence upon fat secretion tending to raise the percentage of fat in the milk. Support for the latter observation is also given in another Report (Ref. 63), in which an account is given of observations on two herds of 25–28 cows which received 2 lb. of cacao shell per head daily for twelve months, along with the usual dairy ration. The cows remained in good health throughout and maintained their normal yield of milk. It is advised in this report that cacao shell should be regarded as a fodder rather than as a concentrate, and that, in view of its content of the alkaloid theobromine, the allowance to a cow

should not exceed 2 lb. per day. This quantity should safeguard the needs of the cow for vitamin D, enrich the butter in this vitamin, and possibly tend to raise the fat-content of the milk.

Heather.

Two reports issued during the year have dealt with the composition and nutritive value of heather (*Calluna vulgaris*). In the first of these (Ref. 64) the results are summarized of the analyses of 63 samples of the edible shoots of heather collected from five different centres in Scotland. On the average, the dry matter showed the following percentage composition: Crude protein, 8·06; ether extract, 2·73; fibre, 25·18; ash (free from silica), 2·13; lime (CaO), 0·54; phosphoric acid (P_2O_5), 0·20. The percentages of protein, ash, lime and phosphoric acid tended to fall, and of ether extract and fibre to rise, with age. The advance of winter caused a fall in the percentages of protein and ash. In the young heather only about 10 per cent. of the crude protein was in the form of "amides," whilst in the older samples practically all the nitrogenous matter was true protein.

In the second report (Ref. 65), similar data are given for samples collected at different times of the year from areas of "dry moor" in Northumberland that had been burned 3, 5 and 7 years previously. In the youngest heather crude protein was at its maximum in June, but in the older heather the seasonal variation was less marked. Fibre was lower in January in samples of all ages than at other seasons. Ether extract was lowest in June for all ages, and there was little difference between autumn and winter samples. In young heather, lime and phosphoric acid were highest in June and July. The general conclusion is drawn from the data that the feeding value of young heather is highest in early summer and lowest in early winter, but that five years or more after burning there is little seasonal change in feeding value.

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REFERENCES.

1. Roberts, E. J. Grass drying. (H.M. Stationery Office.)
2. Waldegrave, The Earl, and Price, W. T. Grass drying. *Bath and West and Southern Counties Journal*, 1936–37.
3. Norman, A. G. *Agricultural Progress*, XIV, 141.
4. Jones, Ll. I. *Empire Jour. Exper. Agric.*, IV, 263.
5. Kirsch, W., and Others. *Die Tier-ernaehrung*, VIII, 261.
6. Kirsch, W., and Jantzon, H. *Die Tier-ernaehrung*, VIII, 354.
7. Hansson, N. *Die Tier-ernaehrung*, VIII, 499.

8. Thomas, B., and Boyns, B. *Empire Jour. Exper. Agric.*, IV, 368.
9. Nehring, K. *Die Tier-ernaehrung*, VII, 444.
10. Greenhill, A. W. *Empire Jour. Exper. Agric.*, IV, 274.
11. Watson, S. J., and Others. *Jour. Agric. Sci.*, XXVII, 224.
12. Watson, S. J., and Ferguson, W. *Jour. Ministry Agric.*, XLIV, 247.
13. Baseler, K. *Die Tier-ernaehrung*, VIII, 509.
14. Olesen, N. A., and Others. *Research Lab. Roy. Vet. Agr. Coll., Copenhagen, Rep.* No. 172.
15. Watson, S. J., and Ferguson, W. *Jour. Agric. Sci.*, XXVII, 1, 67.
16. Davies, W. M., and Others. *Jour. Agric. Sci.*, XXVII, 151.
17. Fagan, T., and Ashton, W. *Welsh Jour. Agric.*, XIII, 129.
18. Watson, S. J., and Ferguson, W. *Jour. Agric. Sci.*, XXVI, 337.
19. Thorbek, G., and Hutchinson, J. *Research Lab. Roy. Agr. Vet. Coll., Copenhagen, Rep.* No. 171.
20. Vail, C. E., and Others. *Colorado, Exp. Sta. Technical Bul.* No. 18.
21. Smith, M. C. *Jour. Agric. Research*, LIII, 681.
22. Scharpenak, A., and Others. Abstr. in *Biedermanns Zentralblatt, A*, VI, 500.
23. Csonka, F., and Jones, D. *Brit. Food Jour.*, XXXVIII, 1936, 62.
24. Bartlett, S. *Jour. Dairy Research*, VII, 222.
25. Miller, J. L., and Others. *Jour. Agric. Res.*, LIV, 437.
26. Klein, W., and Others. *Zeitschr. Zuechtung. B.*, XXXV, 379, XXXVII, 93.
27. Nehring, K. *Die Tier-ernaehrung*, IX, 79.
28. Morris, S. *Nutrition Abstr. and Reviews*, VI, 273.
29. Lund, A. Abstr. in *Nutrition Abs. and Reviews*, VI, 525.
30. Woodman, H. E., and Others. *Jour. Agric. Sci.*, XXVI, 546.
31. MacDonald, A. J. *Poultry Science*, XVI, 247.
32. Willcox, J. S. *Die Tier-ernaehrung*, IX, 121.
33. Morris, S. *Jour. Dairy Research*, VIII, 118.
34. Edwards, J. *Jour. Dairy Research*, VII, 211.
35. Watson, J. A. S., and Others. *Empire Jour. Exp. Agric.*, V, 180.
36. Woodman, H. E., and Others. *Jour. Agric. Science*, XXVII, 191, 212.
37. Gillam, A. E., and Others. *Biochemical Jour.*, XXX, 1728.
38. Cruickshank, E. M., and Moore, T. *Biochemical Jour.*, XXXI, 179.
39. Hume, E. M. *Nutrition Abstr. and Reviews*, VI, 891.
40. Campion, J. E., and Others. *Biochemical Jour.*, XXXI, p. 81.
41. Watson, C. J., and Others. *Scientific Agric.*, XVII, 11. ✓
42. Hutchinson, J., and Morris, S. *Biochemical Jour.*, XXX, 1682, 1695.
43. Woodman, H. E., and Evans, R. *Jour. Agric. Sci.*, XXVII, 465.
44. Halnan, E. T. *Jour. Agric. Sci.*, XXVII, 126, 137.
45. Moon, F., and Thomas, B. *Jour. Agric. Sci.*, XXVII, 458.
46. Maslieff, I., and Denissoff, I. *Die Tier-ernaehrung*, VIII, 613.
47. Sinclair, R. D. *Scientific Agric.*, XVII, 31.

48. Crowther, C. *Pig Breeders' Annual*, 1937–8, **XVII**, 125.
49. Cruickshank, E. M. *Jour. Agric. Sci.*, **XXVII**, 309.
50. Hirzel, R. *Jour. Agric. Sci.*, **XXV**, 541.
51. Biggar, W. A. *Pig Breeders' Annual*, 1937–8, **XVII**, 136.
52. Petersen, N. *Zeitschr. Schweinezucht*, **XLIII**, 632, 711.
53. Hammond, J., and Murray, G. *Jour. Agric. Sci.*, **XXVII**, 394.
54. Blissett, A. H. *Scottish Jour. Agric.*, **XIX**, 327.
55. Baskett, R. G., and Others. *Jour. Min. Agric., N. Ireland*, **V**, 1.
56. Stahl, W. *Zeitschr. Schweinezucht*, **XLIII**, 455.,
57. Cochrane, J. *Pig Breeders' Annual*, 1937–8, **XVII**, 133.
58. Fishwick, V. C. *Pig Breeders' Annual*, 1937–38, **XVII**, 134.
59. Fingerling, G. *Landwirtsch. Versuchs-Stationen*, **CXXVII**, 157.
60. Fingerling, G. *Landwirtsch. Versuchs-Stationen*, **CXXVII**, 235.
61. Richter, K., and Brueggemann, H. *Die Tier-ernaehrung*, **IX**, 184.
62. Golding, J., and Burr, H. *Agricultural Progress*, **XIV**, 44.
63. Knapp, A. W., and Churchman, A. *Jour. Soc. Chem. Industry*, **LVI**, 29.
64. Lauder, A., and Comrie, A. *Scottish Jour. Agric.*, **XIX**, 148.
65. Thomas, B. *Jour. Ministry Agric.*, **XLIII**, 1050.

SOILS AND FERTILIZERS.

General.

During the year 1934 the laying down of arable land to grass, which had been going on for many years, had slowed down very considerably. In 1935 it actually stopped, and the area under permanent grass decreased while the area under arable cultivation increased. It thus seemed that the various schemes for the development of agriculture were at last increasing the area of land under the plough and bringing to an end the process of laying down to grass which many regard as having gone far enough. But in 1936 the old tendency was resumed and no less than 278,000 acres of arable land were lost to the plough: the permanent grass increased by 184,000 acres and the rough grazings by 14,000 acres, while 80,000 acres went out of agricultural use altogether.

This loss of land to agriculture is at present proceeding much more rapidly than ever it did before: 80,000 acres went out in 1936 and 78,000 acres in 1935: the figures look large, yet even if this rate were continued our agricultural land would still last a little over 300 years. The rate is now, however, increasing, for the loss between 1908 and 1935 amounted to 690,000 acres, an average of only about 25,000 acres a year. If the loss should go on increasing as it has done, our agricultural land would the sooner come to an end. It is impossible to forecast what the result may be: one can only hope that the process will slacken off again and even that some of the land now lost may be restored to agricultural use.

The figures showing the utilization of the land are as follows:

Utilization of Land—England and Wales.

	Millions of acres.		
	1908.	1935.	1936.
Total Area	37·13	37·13	37·13
Cultivated area	27·35	24·96	24·86
Arable land	11·41	9·40	9·12
Permanent Grass	15·94	15·56	15·74
Rough Grazings	3·72	5·42	5·43
Non-Agricultural land	6·06	6·75	6·83
Arable as per cent. of Cultivated area	41·7	37·7	36·7
Non-Agricultural land as per cent. of total	16·3	18·2	18·4

Among the arable crops wheat showed the largest fall of 6,800 acres; wheat still remains, however, the chief arable crop, occupying nearly one-fifth of the total arable area. Both oats and barley, on the other hand, increased in area. The sugar-beet area also decreased, though the fall was less than in 1935: the average yield, however, increased and the total output went

up. The area of fruit decreased, particularly that of apples, but it still remained greater than in 1934: the area under vegetables increased. The value of the gross agricultural output for England and Wales was £208,165,000 for 1935–36 which is about £1·3 million less than that of the year before; but since prices had risen the fall in volume of production was proportionately greater. The number of workers fell off by nearly 5 per cent., however, which figure is much larger than the fall in production. Thus the volume of gross production per man employed increased, as it has been doing for some time now. This may mean that the workers are becoming more efficient than they used to be, but the figures also bear another interpretation: they represent the gross output, and include the produce of all the farmers' purchases—stock, fertilizers, feeding stuffs, etc. The only way to get at a figure for the efficiency of the worker would be to find the value of the *net* output, after deduction of these and similar items; but the data for such a calculation are not published.

Fertilizer Consumption.

The consumption of fertilizers shows no falling off. The sales of sulphate of ammonia in England and Wales were larger than in any year since 1932–3, though they fell off a good deal in Scotland as compared with the three years 1931–1934. In Ireland, however, they were larger than in any year except 1931–2. The figures are:—

Fertilizer Trade in Ammonium Sulphate (Ref. 1).
Thousands of Tons per Annum.

	England and Wales.	Scotland.	Ireland.	Total
1930–1	99	39	27	166
1931–2	134	50	45	228
1932–3	151	52	36	239
1933–4	130	48	33	211
1934–5	132	43	35	209
1935–6	137	44	40	222

Sulphate of ammonia is, of course, not the only nitrogenous fertilizer used by farmers: it accounts for only about 70 per cent. of the nitrogen supplied, the remaining 30 per cent. coming from nitro-chalk, nitrate of soda, cyanamide, etc.

The consumption of superphosphate increased in 1935[1] and was higher than in any year since 1931. The same was true of

[1] The superphosphate figures include Ireland as well as Great Britain.

basic slag, but in this case one must go back to 1930 for a better year. On the other hand the consumption of mineral phosphate was a little lower than in 1934, though still well above that for 1931, 1932 or 1933. One of the most remarkable changes since the War has been the large increase in the consumption of fertilizers in spite of the shrinkage in the area of arable land. The increase has been much more marked in the case of nitrogen and of potash than of phosphates, as is shown by the following table :—

Consumption of Fertilizers (Great Britain).

	Thousands of Tons.			
	1913.		1935 (Ref. 2).	
	Actual.	Proportion.	Actual.	Proportion.
Nutrients.—				
Nitrogen (N) (Ref. 3)	36	2·1	63	3·4
Phosphoric acid (P_2O_5) (Ref. 4)	175	10	186	10
Potash (K_2O) (Ref. 5)	23	1·3	78	4·2
In terms of Fertilizers:—	1913.		1935.	
Nitrogenous (20% N)	180		315	
Phosphatic (15% P_2O_5)	1,167		1,240	
Potassic (15% K_2O)	77		260	
TOTAL	1,337		1,815	
Cultivated area, Million acres	31·9		29·6	

There has been a change in the farmer's preference as between the various phosphatic fertilizers; the consumption of superphosphate has fallen, that of mineral phosphate has risen, while that of slag remains about the same as before the War. It is difficult to explain why the use of superphosphate should have decreased, since the experimental evidence in most areas is in favour of it as against the mineral phosphate.

The figures for Great Britain, in thousands of tons, are as follow[1] :—

	1928.	1932.	1933.	1934.	1935.
Superphosphate[2]	686·6	585·3	559·4	602·3	612·1
Basic slag	161·2	155·4	169·3	233·7	284·9
Bone fertilizers	—	—	—	43·0	45·0
Ground mineral phosphate	—	74·5	89·9	107·3	105·4
Concentrated fertilizers	—	1·5	2·6	4·2	5·8

[1] These figures include the consumption in Ireland also.

[2] For these figures I am indebted to Mr. A. N. Gray, Secretary to the Fertilizers Manufacturers' Association, and one of the leading authorities on fertilizer statistics.

THE MANURING AND MANAGEMENT OF CROPS.

(1) *Sugar-beet Fertilizer Requirements.*

The United Kingdom is easily the largest consumer of sugar in Europe, our consumption being 2,283,000 metric tons per annum. The home production is 694,000 tons, *i.e.*, about one-third of the consumption—a remarkable achievement considering how recently the industry was established here. Sugar-beet cultivation has developed so much that the United Kingdom is now the fourth largest grower of the crop in Europe, being surpassed only by Germany, Russia and France.

Thanks to the support of the committee on Sugar Beet Education and Research, an extended series of experiments on the fertilizer requirements of sugar beet has been carried out during the past four years by Dr. E. M. Crowther and other members of the Rothamsted staff (Ref. 6).

The first three years were characterized by hot, dry, bright summers, whereas 1936 was one of the wettest seasons since the introduction of sugar beet into this country. In the first two years the centres chosen were distinctly above the average in fertility, but in subsequent years there were more soils of lower fertility, and the average yield of the experimental crops was close to the country's mean.

A general view of the nature of the fertilizer effect year by year, taken as an average over all soils and also grouped by soil types for 1936, is presented in the following table, the yields being expressed as cwt. of sugar per acre :—

					1936.	1936.	1936.	1936.	1936.	1936.
	1933.	1934.	1935.	1936.	Coarse sands.	Fine sands.	Light loams.	Heavy loams.	Clay loams.	Fens.
No. of centres.	13	15	23	26	6	5	6	4	3	2
Mean Yield .	37·5	47·6	32·4	36·6	35·3	30·8	41·4	36·1	36·9	41·1
MEAN RESPONSE TO Sulphate of Ammonia										
2 cwt. .	+0·37	+1·8	+1·8	+5·5	+8·3	+4·4	+4·0	+4·9	+7·0	+3·1
4 cwt. .	—	+3·0	+2·7	+7·7	+1·6	+5·9	+5·6	+9·2	+9·9	+0·8
Super-phosphate										
3 cwt. .	+0·34	+0·4	+0·1	+1·9	+2·3	+1·8	+3·0	+0·6	+2·5	+1·2
6 cwt. .	—	+1·0	+0·4	+3·0	+4·2	+2·7	+3·7	+1·2	+4·3	+0·2
Muriate of Potash										
1¼ cwt. .	+0·75	+1·4	+0·8	+1·2	+1·8	+2·6	+0·3	+0·2	+0·0	+2·1
2½ cwt. .	—	+0·4	+0·9	+1·9	+3·3	+4·4	+1·5	−1·2	−1·4	+4·2

In 1936 the response to the single application of nitrogen (2 cwt. sulphate of ammonia per acre) was, on the average, when measured in weight of sugar per acre, almost four times as great as that obtained in the three previous seasons ; the double dressing

gave about three times as much as in the earlier years. This difference was mainly accounted for by a larger increase in weight of washed roots, but partly also by the fact that the addition of nitrogen had a much smaller depressing effect on the sugar percentage in 1936 than in previous years. Thus in the three dry years 1933–35 the single dressing of sulphate of ammonia reduced the sugar percentage by 0·25 per cent.; in 1936 the reduction was only 0·06 per cent. For the double dressings the corresponding figures were 0·52 per cent. in 1934–5 and 0·18 in 1936. The effect of sulphate of ammonia on the yield of tops was, contrary to expectation, not much greater in the wet season than in the dry years.

The responses in total sugar, following the use of superphosphate, were quite small in the three dry years but considerable in 1936, being statistically significant at 10 of the 26 centres. In 1936 phosphate also had a marked effect on the yield of tops, the average increase being 0·72 tons for the 6 cwt. dressing. At several centres in 1936, and especially on the heavier soils, the effect of superphosphate in hastening the development of the plant was very marked.

The single application of muriate of potash (1½ cwt. per acre) gave much the same increase in 1936 as in previous years, but the double dressing was distinctly more effective. When the results are examined on the basis of soil type it is seen that potash was highly effective on the lighter soils but not on the heavier types. Although 1936 provided so many contrasts with the previous years, the well-known effect of potash in increasing the sugar percentage of the roots was much the same in all years, the figures being :—

Muriate of Potash.	Increase in sugar percentage.			
	1933.	1934.	1935.	1936.
1½ . .	+0·15	+0·23	+0·16	+0·14
2½ . .	—	+0·22	+0·24	+0·24

In addition to testing the average over-all effects of the several nutrients, the experiments were designed to discover how far the response to any one fertilizer depended on the presence of another. The only general effect was between nitrogen and potash. In each of the years 1934 to 1936 the response to either fertilizer, measured in sugar per acre, was about 2 cwt. greater in the presence than it was in the absence of the other. This positive interaction, which appears to be independent of seasonal effects, emphasizes the importance of preserving a proper balance between nitrogen and potash in fertilizer mixtures for sugar beet.

A series of experiments with nitrogenous manures, begun at Sprowston in 1925 and continued since, has been summarized by E. T. Sykes (Ref. 7). The best effects were obtained with 4 cwt. nitrate of lime, or 3 cwt. nitrate of soda, per acre. Sulphate of ammonia did not act as well as nitrate of soda. Early application was better than late, and the best results, especially on the light loams, were obtained by putting the nitrogenous manure in the seed bed.

(2) *Malting Barley.*

A third conference on the growing of malting barley was held at Rothamsted on December 2nd, 1936, on the lines of those that had proved so successful in the two previous years. Samples were sent in by growers from all the important barley-growing districts, each being accompanied by full agricultural details. These samples were graded by an expert committee of valuers and were then displayed at the conference to provide the basis of a discussion on the technical problems of barley growing. The grading distinguished six classes denoted by the letters A to F. Those in grade A were quite exceptional barleys of the very finest quality, and all grades from A to D would have been used by some brewers for their pale ales. Grades E and F comprised barleys that would have met a good demand for mild ales and stouts. All grades therefore represent malting barleys, the price range being about 5*s.* per quarter from each grade to the next.

Almost half the samples fell into class E, and there were more in class F than in class D. The Kent samples were of Plumage Archer, while the Norfolk and Suffolk samples were of Spratt Archer or the rather similar New Cross; other counties sent in both Plumage Archer and Spratt Archer.

The spring-sown barleys which graded best had also the highest yields, but this did not apply to the autumn barleys :—

Average yield, bushels per acre, by grades (all districts).

Grade.	Spring sown.	Autumn sown.
A, B, C	46	37
D	41	40
E	42	41
F	37	39
Mean	41	39

The soil type did not affect the quality as much as might have been expected, but this means only that good samples can be grown on all types of soil—light, medium and heavy. Very early spring sowing did not give specially good results, but late sowing (after the end of March) led to poor quality. Few of the barleys grown after organic manures got into the top grades;

most of the high-grade samples had been grown with artificial manures which almost always included a nitrogenous manure—usually 1 cwt. sulphate of ammonia. There had been more lodging in the lowest-grade samples than in the others (Ref. 8).

(3) *The Value of Dried Poultry Manure.*

Experiments on the fertilizing value of dried poultry manure were begun by the Rothamsted staff at a number of centres in 1933 and have since been continued (Ref. 9). The average composition of the poultry manures used in the past four seasons has been :—

Nitrogen, 3·65 per cent. ; phosphoric acid (P_2O_5), 3·44 per cent. ; potash (K_2O), 1·68 per cent.

There is thus, on the average, almost as much phosphoric acid as nitrogen, but the amount of nitrogen may vary considerably according to the rations fed or the condition of the herbage of the poultry runs. The material was dried to about 88 per cent. dry matter and was very dirty and unpleasant to handle. The ash content was about 35 per cent.

The results of the first three years (they were years of dry summers) showed unmistakably that the immediate effect of poultry manure was generally less than that obtained from an equivalent amount of inorganic fertilizers. Thus at 29 centres, all showing clear-cut responses to nitrogen, the average response to poultry manure was about three-quarters of that obtained from an equivalent dressing of sulphate of ammonia and superphosphate. A smaller number of experiments gave some indication of an appreciably greater residual value from poultry manure than from sulphate of ammonia, but these residual effects were small in comparison with the immediate effects. When, however, the dressings were repeated the poultry manure proved better than the sulphate of ammonia—it had a cumulative effect.

The results in 1936 may be summarized as follows :—

Mean percentage increases over no Nitrogen.

	No. of experiments.	Sulphate of ammonia.	Poultry Manure.	Difference.
Immediate effects . .	14	35·2	25·0	−10·2
		(Sulphate	of ammoni	a better).
Cumulative effects 2nd and 3rd year . .	7	30·3	37·1	+6·9
		(Poultry	manure be	tter).

For crops requiring a good supply of active nitrogen, *e.g.*, kale and roots, sulphate of ammonia showed a marked superiority to poultry manure, but there were indications that poultry

manure might have special value for certain other crops—runner beans in 1936, brussels sprouts in an earlier year. If the full-scale experiments of 1936 are grouped according to crops we obtain :—

Crop.	No Nitrogen.		Single Nitrogen.	Double Nitrogen.
Kale, tons per acre	9·2	Sulphate of ammonia	11·6	14·2
		Poultry manure	9·6	10·4
Roots, ,,	20·6	Sulphate of ammonia	22·9	24·2
		Poultry manure	22·3	22·6
Potatoes, ,,	5·7	Sulphate of ammonia	7·6	7·4
		Poultry manure	7·1	7·9
Runner beans, cwt. per acre	40	Sulphate of ammonia	41	46
		Poultry manure	51	64

(4) *The value of Organic Matter: Farmyard Manure and Composts.*

Lawes and Gilbert at Rothamsted and the Voelckers at Woburn showed that good crops of cereals could be obtained year after year from artificial fertilizers only, without the use of farmyard manure : this was put into practice by several large farmers—Mr. Prout of Sawbridgeworth, Mr. George Bayliss of Wyfield Manor, near Newbury, and others. Neither Lawes, Gilbert nor the Voelckers, however, went so far as to say that farmyard manure was unnecessary, and indeed, both at Rothamsted and at Woburn, difficulties have been met in trying to grow sugar beet or potatoes without it. Some of the chemists of the 19th century, however, went further than the great leaders, claiming that artificial fertilizers, if properly used, could wholly replace farmyard manure; and until comparatively recently a scientist was always (though usually quite wrongly) supposed by farmers to be a supporter of artificials against farmyard manure.

In spite of a great amount of experiment, the effects of farmyard manure cannot yet be fully explained. The food substances present—the nitrogen, phosphoric acid and potassium—are not as effective as those in the standard artificial manures. One hundred parts of nitrogen in farmyard manure has about the same value as 50 in nitrate of soda or sulphate of ammonia, and although no good comparison with potash has been made there is no reason to suppose that the farmyard manure is any better than, even if it is as good as, the ordinary potassic fertilizers. For the phosphate there is no evidence one way or the other ; it is possible that the organic phosphorus compounds of farmyard manure may have some special value on phosphate-starved land, though superphosphate is so strikingly effective in such cases that careful experiment would be needed to establish any superiority.

If the nutrients are no better, the advantages of farmyard manure must lie in some property other than its nutrient content. Its mechanical effect on the soil is, of course, well known, and is probably attributable to the large amounts of straw present and to the fact that the decomposition to form humus has already started.

There still remains, however, the possibility that some of the other substances present in farmyard manure may have some special action. Some very remarkable effects of small dressings of farmyard manure in Kenya were described in the last report; for these no explanation could be given, and they therefore might be attributed to some mysterious action of an unspecified constituent. This question has now been studied in more detail by Hartley (Ref. 10), who finds that the effect can be perfectly well explained as due to the phosphorus present in the manure; he was able to reproduce it entirely by a small dressing of superphosphate.

(5) *The use of Straw as Manure.*

Mechanization, and the depression in the live-stock industry, have together brought into prominence the question of disposing of straw to the best advantage. It has become increasingly difficult to obtain adequate amounts of farmyard manure. Unrotted straw, ploughed in by itself, depresses the yield of the subsequent crop, as Lawes showed many years ago; the extra supply of carbonaceous material results in a locking-up of available nitrogen in the organisms that decompose the straw. Some years ago long-range rotation experiments were laid down at Rothamsted to test, among other things, various methods of utilizing straw. One trial is on a four-course, the other a three-course rotation. The results of the first complete rotation are now available (Ref. 11).

In the four-course rotation experiment the effects of farmyard manure, of "Adco," and of straw *plus* artificials, are being compared, both in the year of application and in the four succeeding years, the plots receiving their manures once every five years. All three organic manures have given a good increase in the year of application, a much less effect in the first year after application, and only a small effect, if any, in the second year. The straw mixed with artificials has done quite well, and this seems a promising method, which will be further studied.

The three-course rotation experiment is on somewhat similar lines, its purpose being to clear up some of the details. It agrees with the other in indicating that the mixture of straw and artificials is quite promising. Both experiments must, however, continue for a longer period in order to show how straw with artificials compares with a proper mixture of artificials alone.

In another experiment straw was added to the farmyard manure to increase its amount, and the mixture was then used for potatoes. The straw lowered the value of the farmyard manure and led to a depression of the yield. Where, however, artificials were added, so as to facilitate the rotting of the straw, the yield was increased.

(6) *Green Manuring.*

Green manuring is an old and well known method of improving the supply of organic matter in the soil, but unfortunately it is very difficult in practice to make sure of good results. The Woburn experiments have shown that, unless certain conditions are fully satisfied, the method fails altogether. An interesting and important method has been worked out by Mr. R. L. Scarlett (Ref. 12) of Sweethope, Musselburgh, for cleaning weedy land and at the same time increasing its fertility. Starting out from the well recognized fact that much arable land is to-day suffering from too many weeds and too little humus, he set out to kill two birds with one stone and convert the harmful weeds into useful humus. The method consists in ploughing the land during winter or early spring and sowing it, in February or early March, with tares at the rate of 1½ cwt. per acre; when these come into first flowers in late June they are mushed up with a heavy implement and 3 or 4 cwt. per acre of cyanamide is applied (this should be done early in the morning when the dew is still on the tares). The field is then left alone for six or eight days, when it is ploughed, and rye is sown not later than the third week of July. This produces a mass of green material and roots, which are ploughed in during autumn and are followed in April by potatoes or by a green crop.

The cyanamide supplies both the nitrogen and the calcium carbonate shown by Hutchinson and Richards to be necessary for the decomposition of vegetable matter: in consequence both weeds and green manure crops rot down rapidly and furnish valuable organic matter for the soil. In the one season the weeds are completely subdued, however bad they may have been. The cost works out to about £12 per acre. and as Mr. Scarlett observes, it is very doubtful whether ordinary cultivation and dunging could be done at this price, or if so whether it would be so effective. No hand labour is needed, and the tractor work can be done in intervals between other work. The scheme certainly seems worth wider trial. Bare fallowing in Scotland, the author states, is practically useless.

(7) *Green Manuring in Tropical Countries.*

Green manuring is much practised in tropical countries. Tea plantations make much use of it in Assam, in South India,

and in Ceylon (Ref. 13). Long-growing leguminous crops such as Tephrosia and the Crotolarias are used, and in Assam give better results than shorter-growing crops.

Some interesting work on this subject is being done in Southern Nigeria. Earlier experiments by O. T. Faulkner (Ref. 14) showed that soil fertility could be effectively maintained on the experimental farm in Southern Nigeria by green manuring with a leguminous crop (*Mucuna utilis*) but that equally good results were obtained whether the *Mucuna* was buried green or cut, allowed to dry and burnt *in situ*. H. C. Doyne (Ref. 15) has now investigated this problem still further. He shows that turning in a green cover crop increases the content of nitrogen and nitrate in the soil, while burning the cover crop raises the pH value and the available mineral content. For five years now the burnt plots have been as good as the green-manured plots, and the work is being continued indefinitely in order to find out how long this state of affairs will continue, or whether a time will come when nitrogenous fertilizer must be added.

It is remarkable that the added nitrogen in the green cover crop has had no effect on the productiveness of the soil, but this, after all, agrees with the results obtained at Woburn and at various other centres, where a time-gap between the ploughing in of the green crop and the sowing of the main crop allowed the nitrate to be lost through drainage, and therefore missed by the plant. Earlier experiments in Nigeria have shown that there the production of nitrates is extremely rapid when the rains break after the dry season, and that a further flush occurs after the short dry season in August. This rapid nitrification suggests that the dry season may exert a partial-sterilization effect, which might be valuable if plants could immediately take up the nitrate; but the rapidity of nitrate production involves the risk that the nitrates may be washed out by the rain.

J. J. Theron (Ref. 16) concludes that green manuring has no economic justification under dry-land farming conditions with a summer rainfall in South Africa. In the region studied the fertility of arable land could be adequately maintained by artificial fertilizers alone. Theron suggests, however, that as an alternative to green manuring the soil should be put down to grass for a period of years in order to re-establish the humus balance and thus automatically increase fertility.

(8) *Household Waste: Recent Changes in its Value.*

Farmers near to towns have long used household waste as manure, especially when they have been able to get it cheaply. Its character appears to be changing but it is difficult to see how far its manurial value will be affected. This problem was discussed by H. Edridge in an interesting paper before the

Institute of Cleansing (Ref. 17) setting out the results of an enquiry into the quantity and composition of the refuse of a number of provincial towns representing a total population of 6·4 millions, residing in 1·66 million houses. The weight of refuse per head appears to be getting less as the standard of housing is improved, which change Edridge attributes to the improvement in the stoves. From the agricultural point of view the important point is that the proportion of paper is increasing. In the samples examined in 1935–6 the proportion averaged over 14 per cent., against 11 per cent. in 1933–4. This increased proportion of paper makes the material more bulky and probably detracts from its fertilizer value. Metal containers (*i.e.*, tin cans) are increasing also. It is estimated that 46 tins per head of population are now used each year in this country, but as the Americans use 94 per head per annum we still have a long way to go to catch them up. The cinder, which is useful in lightening heavy soils, also decreased during the period, and amounted to only 6 per cent. of the large and 14 per cent. of the small material. The only ingredient of fertilizer value is the vegetable matter which, on the average, amounted to 13·2 per cent. in 1935–6 against 11·8 per cent. in 1933–4. The amount of vegetable matter varies with the class of house, being greater from the better class (16·3 per cent.) than from the artisan class house (10 per cent.). Also it is much higher in summer (up to 28 per cent. from the better class house) than in winter. A farmer who could stipulate that he was to receive household waste only from "the nobility and gentry," and only in summer, would have a much better bargain than one receiving the waste from artisan households. In winter these differences, oddly enough, disappear and all kinds of households come to the same level of about 8 per cent. vegetable matter. From an area scheduled for slum clearance the refuse was mainly dust and cinders and contained only 2·9 per cent. of vegetable matter. The importance of household waste arises from the circumstance that there is so much of it—over eight million tons a year for a population of 40 million. Of this total one-and-a-half million tons is burnable cinders and over one million tons is vegetable and putrescible matter having manurial value, apart from 40,000 tons of bone. At present over £1,000,000 a year is spent in disposing of this material.

Various processes are now being tried for making a useful manure out of this waste: it is to be hoped that something may come of them.

In India, where water-borne sewage systems are not in common use, the disposal of household waste is linked up with the disposal of night-soil. In Madras a "poudrette" has been made by mixing both substances: it contains nearly 0·5 per cent. of nitrogen, and in field trials at Anakapalle proved almost as

good as farmyard manure. A large amount is said to be available (Ref. 18).

(9) *Composts.*

While composts are of little agricultural interest in this country they are of value for horticulturists. The conditions for making them were worked out by Hutchinson and Richards at Rothamsted in 1921, and a summary of the methods suitable for use by market gardeners and others has been drawn up by H. V. Garner (Ref. 19).

Deficiency Diseases of Crops.

(1) *Deficiencies of Major Nutrients.*

A useful publication issued by the Potash Syndicate describes and illustrates the symptoms of potash deficiency (Ref. 20); this subject is referred to on page 236.

The part played by potassium in the economy of the plant has been much investigated by Dr. G. Rohde, especially its function in the assimilation of carbon dioxide, in the making of chlorophyll and the development of roots (Ref. 21).

(2) *Minor Elements in Plant Nutrition.*

This subject continues to attract considerable attention. It was dealt with at some length in last year's report, and only a few new references need now be given.

W. A. Roach (Ref. 22) has devised an ingenious method for discovering which of the minor elements are lacking in the nutrition of fruit trees and also a means for supplying them. In a recent paper he has dealt with the shortage of iron which causes the yellowing of the leaves called *chlorosis* in plants growing on calcareous soils. The condition is often called "lime-induced chlorosis." Apparently, however, it is due not to the presence of excess lime, but to the absence of available iron. The veins of the leaf, and the parts near them, may remain green but the rest of the leaf turns yellow: this characteristic distinguishes lime-induced chlorosis from a somewhat similar trouble caused by lack of nitrogen in which, however, the whole leaf turns yellow. Addition of iron salts to the soil has proved of no avail, but the injection of iron into the tree was more successful. Details still have to be improved but the general principle seems sound.

In other parts of the country other elements may be lacking. There are indications of shortage of magnesium in parts of Cornwall; elsewhere manganese, copper or zinc are lacking. Chlorosis is the main symptom in all these cases and it is difficult, if not impossible, to distinguish by eye one form of chlorosis from another. Roach's method, however, shows clearly which particular element is deficient.

A disease of apples on the trees, which is troublesome both in New Zealand and in Canada (but not, apparently, here) and is known as drought-spot or superficial cork, is associated with a lack of boron, and can be cured by injecting boric acid into the tree or by spraying it on to the foliage. This and other "functional disorders" have recently been described by Hill (Ref. 23).

Observations on other crops (Ref. 24) are adding to the number of "deficiency diseases." Boron in particular is more frequently lacking than was formerly suspected, and now that growers can recognize Heart Rot or Crown Rot in sugar beet (which is due to the lack of boron) the condition is being found to be fairly widespread. Swedes suffer from Brown Heart when boron is deficient (Ref. 25). Potatoes are apparently affected also, but in a different way, the symptoms being rather like those of Leaf Roll (Ref. 26).

Application of borax at the rate of 20–28 lb. per acre appears to be a suitable remedy. Great care is needed, however, for it is easy to overstep the limit of safety, and to do harm. Heart Rot of sugar beet and fodder beet also occurs in France and it is remedied in the same way, by treatment with boron (Ref. 27).

Cobalt is another element on which a good deal of work is now being done. Its importance was first shown in Australia, where it was found to remedy a live-stock disease associated with certain pastures. The same disease has now been found in New Zealand, and has again been cured by small doses of cobalt salts. It is not known whether the cobalt is needed for the plant as well as for the animal; the evidence is that it is usually present in plants, though only in very small amounts. Experiments with elements that are required only in minute quantities are very difficult to carry out, and although the evidence seems satisfactory it has been claimed that in this case the true curative agent is iron and not cobalt (Ref. 28).

Organic Substances: Plant Hormones, etc.

The remarkable effects on animal growth of those curious substances called vitamins has naturally led to experiments to find whether similar substances function in plant growth. There is, of course, so great a difference between plants and animals that no surprise would be felt if their growth mechanisms were different; the case is entirely one for experiment and not for speculation.

Earlier work showed that extracts of farmyard manure, horse manure, decomposed peat, etc., had remarkably stimulating effects on the growth of some of the lower plants, and some people jumped to the conclusion that they might probably have similar effects on crop growth. Further and better experiments showed that many of these effects could be explained quite well

as due to the iron, manganese or other mineral elements present in the extracts, and that there was no need to assume any specific effects from the organic matter. Later work shows quite clearly, however, that organic substances do exist which greatly affect the method of growth: they do not actually increase it, but they direct it into various channels much in the same way that a policeman may direct streams of traffic (Ref. 29). The literature on the subject is very scattered, but two useful reviews have recently been issued which summarize the present position quite well. One of these is by P. Boysen Jensen (Ref. 30) who has done a great deal of work on the subject during the last 26 years. He showed long ago that the well-known turning of the leaf to face the light is associated with some substance sent through the leaf (presumably as a regulating or directing body) and that this substance can pass through a film of gelatin. The lengthening of the young stem or leaf is likewise known to be associated with a substance which can also be passed out into gelatin. If this substance is put on to one side of the young stem,[1] that side will lengthen more than the others so that the stem bends. All this, however, does not mean increased growth but only a different direction of growth. The substance that stimulates the lengthening of the young stem of the oat retards the growth of the main roots (Ref. 31).

Flowering and other phases of growth in hyacinths are also controlled by substances of this sort, but again the function of the substances is to direct the expenditure of the stock of plant material, not to increase it; indeed Jensen thinks it likely that the acceleration of flowering is associated with a depression of root growth and total dry-matter production. He thinks that if these growth-stimulating substances occur in soils (which, however, has not yet been shown) their effect will probably be to reduce root growth and dry-matter production. These substances are called "auxins": they actually occur in the plant.

Another group of auxins is associated with root development, but these again cause no increase in total growth; the extra root development is at the expense of a fixed total of plant material, and less remains available for the plant's other needs.

All this research was of purely physiological interest till recently, when technological chemists have succeeded in preparing some of these auxins on a large scale. The root-forming substance (*rhizopin* or *hetero-auxin*: chemically 3-indolylacetic acid) can be manufactured for practical use. Its first applications are likely to be in horticulture. A review of the possibilities as they appear at present has been published by M. A. H. Tincker of Wisley (Ref. 32). Cuttings of plants (*i.e.*, holly) soaked in

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[1] Actually the coleoptile.

rhizopin send out rootlets very quickly (Ref. 33). Stems of tomato plants coated with a mixture of lanoline and rhizopin thicken and curve within a few hours, and roots begin to form within a week; leaves also can be made to produce roots. These results obviously suggest the possibility of valuable practical developments in connection with plants, such as the mango, that do not easily produce roots from cuttings.

The speeding-up of the flowering of hyacinths is another process of obvious practical interest. Curiously enough œstrogenic substances (the sex hormones of animals) are effective for this purpose. This was first shown by W. Schoeller of Schering-Kahlbaum A.G. The fact that sex hormones which might have a similar action are known to occur in the urine of pregnant mares suggest that they might also occur in farmyard manure and liquid manure. In consequence Schoeller, with two other investigators (Ref. 34), have examined many samples of manure and have tested the extracts, against properly made preparations of sex hormones, on plants grown in water culture, sand culture and in field plots. The results, however, were not very striking. In the first place, the amount of sex hormone in liquid manure was found to be very small; the urine of pregnant mares contained 100,000 to 200,000 units per litre, while ordinary liquid manure contained only 1,000 to 1,500 units, even where the urine from a large number of pregnant ewes and sows was included. Moreover, the quantity decreased when the manure was stored. Farmyard manure itself was found to contain only 500 units per kilo. The effect of such manures on flowering and growth was very variable but never very marked: an increase in growth (usually of the order of 10 or 20 per cent.) was obtained in some cases but it appeared to be rather a general stimulation than an effect on flowering, and in any case did not seem to be due to the sex hormones. The conclusion of a considerable amount of work is that, while there may be cases where some of these substances have affected plant growth, they are of no particular importance for crop production. The special value of farmyard manure must be explained in some other way (Ref. 35).

Other Types of Fertilizer Action.

Potassium Permanganate.

In 1933 Subrahmanyan and Sidappa showed that small amounts of potassium permanganate and other oxidizing agents (hydrogen peroxide, manganese dioxide, etc.), when added to the soil increased the growth of crops. Other papers have since been published (Ref. 36). The action resembles that of partial sterilization in that the number of soil bacteria is first depressed and then rapidly increases. Greening (Ref. 37) reports that dressings of potassium permanganate increased the growth of grass.

Silicates.

The Rothamsted Hoos Field experiments show that sodium silicate has, in certain circumstances, a fertilizer effect on barley which is specially pronounced when the phosphate supply is deficient. Rice, especially under dry-land conditions, appears to respond to silicates (Ref. 38), but the field work is not full enough to show when or under what conditions this happens. On the scientific side the subject has been further investigated by Achromeiko; he shows that the action consists partly in increasing the solubility of the phosphate, and is partly an effect in the plant itself. Silicates have no effect on the assimilation of nitrogen by plants (Ref. 39).

THE EFFECT OF THE PLANT ON ITS NEIGHBOURS AND SUCCESSORS.

A large amount of experimental work on this subject has been done in recent years and the results are collected in a useful summary by Professor Loehwing (Ref. 40). The best-known case in England is the harmful effect of growing grass on fruit trees, an old observation which was examined in some detail by the late Spencer Pickering. The effect was attributed by him to toxic excretions from the grass roots, but it can also be explained as due to nitrogen-starvation of the trees. A good deal of work is now being done on the influence of leguminous plants on non-leguminous plants growing with them, *e.g.*, the influence of clovers on grasses in mixture with them. Virtanen has shown that leguminous plants excrete from their roots nitrogenous compounds which other plants can take up, and Thornton and Nicol demonstrated that grass in sand cultures benefited by being grown with lucerne. How important this action may be under field conditions is still not clear. Soya beans apparently excrete no nitrogen compounds (Ref. 41).

One crop, however, is definitely known to reduce the productivity of the soil after it is removed, so that its successor suffers. This is the sorghum crop (great millet, durra, Kaffir corn, etc.) much grown in the warmer parts of the Empire. Two effects seem to be produced. During its growth sorghum causes an accumulation of sodium in the soil; the effect is to spoil the soil texture, making it more compact, less permeable to water and, generally speaking, less suitable for plant growth. This was shown in 1924 in the United States by Breazeale and by Hawkins (Ref. 42) and has recently been confirmed by Ayyar and others at Coimbatore, Madras (Ref. 43).

Another action appears to be that the considerable amount of sugar in the sorghum residues causes the soil organisms greatly to multiply and so to consume the nitrates which the succeeding crop would otherwise have had; this, however, is only a temporary trouble.

Numerous analyses show that growing plants, towards the end of their lives, lose a certain amount of material. Crops fall into two groups in this respect. One group, which includes grasses, cereals, roots, vegetables, etc., do not, under ordinary conditions of growth, pass out phosphoric acid from their roots into the soil; they can, however, excrete potash. The second group, which includes leguminous crops and oil seeds, readily excrete phosphoric acid, especially at flowering time. The first group contain considerable amounts of carbohydrate and have a more or less neutral sap, while the second group contain much protein and fat and have an acid sap. These latter plants have the power of taking up from the soil insoluble phosphates (which are unavailable to the plants of the first group) and the phosphate which they excrete is in a soluble and readily available form (Ref. 44).

Although it is uncommon in England, a great amount of mixed cropping is done in various parts of the Empire, particularly in India, and the system has numerous advantages.

The Effect of Soil Conditions on Plant Diseases.

This Report does not deal with plant diseases except in so far as they are influenced by soil conditions. Of late years we have heard a great deal about Whiteheads or Take-all, a disease of wheat which is becoming more prevalent on the lighter soils of Norfolk, Hampshire and the Yorkshire Wolds, especially where mechanization has led to the more frequent recurrence of wheat crops on the land. Much useful information on this disease has been collected by G. Samuel (Ref. 45). In the old four-course rotation there was little danger of Take-all and one heard nothing about it. The disease organism—a fungus called *Ophiobolus graminis*—carries over in the stubble and dies as soon as the stubble rots, so that it becomes serious only when wheat is sown on an infested stubble which still persists. It is doubtful whether the disease could persist as long as a year, and a break in fallow, or under some non-cereal crop such as sugar beet, should suffice to clear the land. The disease is more troublesome on light than on heavy soils: on alkaline than on acid soils: and on soils poor in organic matter rather than on soils well supplied. Investigations in Canada and the United States suggest that the presence of organic matter somehow checks the growth of the fungus, which effect is attributed to the antagonistic effects of certain soil organisms. S. D. Garrett (Ref. 46) has studied the effect of acidity. Australian experience suggests that the trouble is mitigated by compacting a light soil and by properly manuring the crop.

Wheat is the crop most affected and barley is also liable to attack. Oats are less susceptible; under the dry conditions of

Australia they are practically immune, but under the moister English conditions they can be attacked. Many grasses also are susceptible, particularly barley grass, while ryegrass is very resistant. In planning a rotation susceptible crops should not follow each other too closely..

S. D. Garrett has also collected an account of the various methods for controlling soil-borne fungus diseases (Ref. 47). He points out that the search for resistant varieties of crops—which would be the best way out of the difficulty—is usually successful only for the more highly specialized parasites with a very limited host range; hence some control measures are usually necessary. Three groups of methods have been devised: those aiming at eradicating the fungus during its resting phase in the soil; those dealing with it in its active phase on the roots and other underground parts of the plant; and those aiming at the prevention of the dispersal of the fungus to fresh areas. The destruction of the fungus during its resting stage may be effected by simple starvation (aided by the action of other soil organisms) if the rotation is long enough and provided that there are no host plants among the weeds. There is, however, always an element of risk in this procedure. Steam sterilization is often adopted in glasshouse practice, but this has the disadvantage that sterilized soil is usually a very good medium for the growth of the fungus if ever it should get back again. Chemical treatment has not usually succeeded on the large scale. Garrett attaches importance to the possibility of stimulating the activity of other soil organisms in destroying the fungus or its spores. This stimulation can be brought about by putting into the soil suitable organic matter in order to promote their multiplication. Control during the active period (when the fungus is attacking the plant) may be effected by making the conditions of growth better, thus improving the vigour of the plant. For example, the serious root-rot of sugar cane in Hawaii, the West Indies and elsewhere (Ref. 48), and the brown root-rot of cereals in Canada (Ref. 49), are both caused by the fungus *Pythium arrhenomanes*, but this is harmful only when phosphate is lacking in the soil. A serious root infection of cotton in the Sudan, associated with various fungi, becomes serious only when soil aeration is defective.

"Rogueing" is another method of dealing with fungus diseases: it has succeeded fairly well on the Malayan rubber plantations (Ref. 50) but has not usually proved effective elsewhere. For other diseases it may be possible to alter the soil conditions so as to make them unfavourable to the fungus while leaving them favourable to the plant; thus potato scab (Ref. 51), cotton root-rot (Ref. 52), and take-all of wheat (Ref. 53) are all decreased by applying organic manure or by ploughing in green crops: these increase the activity on other organisms

which destroy the disease fungus. Other diseases can be controlled by changing the reaction of the soil. Some diseases are more likely to occur on certain soil types than on others: thus the Panama disease of bananas is most prevalent on light sandy soils (Ref. 54). Andrews has confirmed and extended an earlier observation of Massey that the flooding of land infected with black-arm of cotton kills the organisms and so controls the disease (Ref. 55).

Soil Insects.

Those who were farming during the War will remember the very serious trouble caused by wireworm as soon as the ploughing up of grass land began. No effective method for dealing with this pest was then known, nor has one since been found, but experiments have been carried on for some time at Rothamsted by W. R. S. Ladell and some definite progress has been made.

Hitherto the great difficulty in making any experiments on soil insects has been to estimate their numbers in the soil; it has been possible only to say that they were few or many, or that a given treatment appeared to have encouraged or depressed them. Ladell (Ref. 56) has devised a flotation method whereby the insects in a sample of soil can be got out and counted, so that he is able to show definitely the effect of any particular treatment on their numbers, and to follow this up by further observations on the subsequent recovery after any attempt at suppression. A sample of 4 to 8 lb. of soil is stirred up in a strong solution of magnesium sulphate (specific gravity 1·11) through which a fine stream of air bubbles is continually blown. The insects, which are all lighter than the solution, rise to the top and are slid off on the froth first into a settling chamber where the soil is deposited and then on to a filter paper. The magnesium sulphate flocculates any clay in the soil and is so little toxic that insect eggs removed can be hatched out.

The figures obtained by this method are very much larger than those found by Morris's earlier method. For the Broadbalk soils the following results, in millions per acre, were obtained by Ladell's apparatus :—

	Total Invertebrates.	Insects only.
Manured . . .	84·6	69·3
Unmanured . .	38·2	33·5

These figures are nearly 10 times Morris's values.

K. D. Baweja has examined 300 samples of soil in 14 months, and the maximum number obtained indicated a population of 486 millions of soil animals per acre; the total included 475 million insects, of which the majority were Collembola. Baweja has also studied the return of the fauna to soil which had been completely sterilized by heating to 212°F. He used plots of 9 feet by 9 feet and took the samples from an inner square of

7 feet by 7 feet. Four plots were sterilized in February and four in May, in each case to a depth of 12 inches. Two plots of each set were isolated by a barrier to a depth of 12 inches from the surrounding ground, so that recolonization was possible only from above and below.

His results, briefly stated, are :—

(1) The time taken for the sterilized plots to build up a population equal to that of the control averaged seven months in the case of the unenclosed plots and five months in the case of the enclosed ; these figures apply to both times of sterilization, viz., February and May.

(2) The return of the insects was more rapid than that of any other group.

(3) Collembola and Diptera (flies and their grubs) predominated, with Coleoptera (beetles) and Hemiptera (bugs) next in importance.

(4) Both sterilized and control plots showed a peak of population in late autumn (October and November).

Ladell has carried out a series of field experiments on the effect of insecticides on wireworms and on the oat eelworm (*Heterodera Schachtii*).

Soil Fungi and Actinomycetes.

Studies of the fungi and actinomycetes (a group of primitive fungus-like plants) of some of the Rothamsted soils show that these organisms are more numerous and varied on fertile than on poor soils. The numbers showed no clear periodicity, though they seemed to be lower in winter than in summer. There was no evidence of any specific soil microflora determined by particular manurial treatments, but certain forms were more prominent under continuous mangold growing than under continuous wheat ; in the former case, *Penicillium* and forms of *Dematium*, and in the latter case (under wheat) *Fusaria* were more prevalent (Ref. 57).

Soil Algæ.

Prof. Fritsch (Ref. 58) has brought together the known facts in regard to the life of algæ in the soil. Starting from Dr. Bristol's investigations (which show that, in the Rothamsted soils, algæ were numerous at the surface and again at a depth of 4 inches below the surface) Fritsch inclines to the view that only those forms near the surface are likely to play any part in relation to soil fertility. Here they increase the supply of organic matter, they may help to bind the soil and, in association with bacteria, to fix nitrogen. On the other hand, those buried 4 inches in the soil are, he thinks, inactive. Presumably they get washed down there, but whether they ever get up again is not known.

Algæ have been supposed to play an important part in the aeration of the roots of rice grown in water or in waterlogged soil. In Java, however, this view is not accepted: there it has been shown that the roots do not in fact need oxygen, and that the plant is not injured when nitrogen or even carbon dioxide is bubbled through the culture solution in which it is growing.

CULTIVATION.

For a number of years experiments on cultivation have been made at Rothamsted (Ref. 59) and these have brought out the important fact that the value of cultivation lies not so much in the work itself as in the circumstances under which it is done. Neither subsoiling nor twice ploughing (autumn and spring) had much effect on the yield of sugar beet. Heavy rolling increased the yield of sugar beet only where sulphate of ammonia was given. Rolling and harrowing increased the yield of wheat, both of grain and straw, but rolling alone increased only the straw and not the grain. Inter-row cultivations, beyond a minimum amount needed for keeping down weeds, had no beneficial effect on the yield of sugar beet, kale or potatoes. In ten years of experiment, rotary cultivation did not prove as effective as the standard methods of ploughing and harrowing, whether for swedes, mangolds, wheat or barley, but it was better than the cultivator alone, especially if this was used only to a shallow depth. There was no advantage in ploughing deeper than 4 inches for cereals, but for mangolds it was better to plough to a depth of 8 inches. Once in a way, if time is pressing, it is possible to omit ploughing and start the seed bed by using the cultivator, putting it in deeper than 4 inches; but this cannot be done more than once, otherwise the yields suffer (Ref. 60). Of course, these results have to be used intelligently.

FALLOWING.

The Rothamsted experiments on fallowing still continue: they show (Ref. 61) that on poor land fallowing has a striking influence on the crop that immediately follows, but that the effect lasts for one crop only and does not show in the second year. On better manured land, the effect of the fallow was very much less, and a wet winter also greatly diminished its value.

LAND DRAINAGE.

In drawing up drainage legislation it is essential to have some basis on which to assess the charges which are levied in the form of drainage rates. The method adopted in the Land Drainage Act, 1918, is to assume that all land up to a contour line drawn 8 feet higher than the level of the highest recorded flood will benefit by the schemes, and is therefore made liable to rates.

Tidal areas, of course, are excepted. In some instances occupiers have objected on the ground that land standing as high as 8 feet above the flood level cannot benefit from drainage operations. The question has recently been re-examined by B. A. Keen (Ref. 62), who shows that this contour is quite a good line to take, and probably as fair as any other.

Electric Heating of Soils.

Mr. F. A. Secrett, the well known intensive market gardener, had tried a large-scale experiment on heating soils for early market-garden crops grown under Dutch lights, but found the cost too great. The results are described by C. P. Quarrell in Ref. 63.

Lime, Limestone and Chalk.

Great interest has recently been aroused in the old practice of liming; unfortunately liming is nowadays less often done than it should be, though its beneficial effects are so well known that there is no need to restate them. By the recent Agriculture Act, 1937, one-half of the cost of lime (the cost delivered at the farm) will be refunded to farmers and horticulturists provided the quantity purchased is not less than 2 tons, that it has been produced in the United Kingdom and that it has been supplied by approved suppliers. Prices are not to exceed those operating on May 1st, 1937. Standard rates of contribution, representing as near as may be one-half the costs, will be paid to farmers who dig and cart their own supplies of chalk.

The best ways of using the lime were recently set out by the writer (Ref. 64). The need for lime depends, of course, on the condition of the soil, but it is not the same for all crops; some are more tolerant of acidity than others. Lime deficiency is masked by farmyard manure, so that a well-dunged soil, though acid, may not show signs of acidity. Potatoes, oats, rye, and lupins are all tolerant of acidity, and a farmer who did not wish to lime his land could probably get along fairly well so long as he confined his farming to these crops.

There are various signs of acidity—patchiness of crops, short, stunted roots, and the prevalence of mayweed and sheep's sorrel.

It is usually on arable land that lime shows up best, and there are some wonderful successes to its credit. Among the most striking are those at Tunstall in Suffolk, where A. W. Oldershaw showed that an expenditure of 50*s*. per acre on chalk resulted, in the first ten years, in increased crops worth £64. This farm is not peculiar; there are thousands of acres like it.

Grassland does not usually show anything like such good responses to lime. Of course, if the acidity is very pronounced, lime must be given, and on some of the Rothamsted grass plots the yield of hay has been increased by about 10 cwt. per acre

simply by adding lime. On the very acid grass plots at Rothamsted the benefit is very marked; the limed plots not only yield more but suffer less than the unlimed from winter frost and from spring drought. These plots, however, were already receiving a complete fertilizer. The unmanured plots and those receiving incomplete manures show no gain from dressings of lime. It used to be thought that lime set free potash from the soil and so did away with the necessity for potash manuring. The Rothamsted grass plots show that that is not so; the plot deficient in potash shows little or no benefit from lime until potash is added. The yields of hay last year in cwt. per acre were :—

Plot.		No Lime.	Lime added.
7	Complete fertilizer . .	40·7	51·3
8	Without potash . .	20·2	17·9

The plots receiving farmyard manure have also failed to benefit from lime; indeed there was some tendency to loss of yield after liming. Some of the northern pastures are greatly in need of lime, but there are other cases where the large amount of organic matter in a pasture or meadow soil masks an ordinary degree of acidity, so that the grass does not need it. The case alters completely as soon as this grassland is ploughed out, for the protecting conditions then change, and the arable land will need lime on fields where the grass did not. The County Organizer can advise as to how much lime should be applied. There is no point in putting on too much; excess of lime over and above what is wanted for neutralizing acidity is liable to waste, and the rate of loss is greater in the surplus than in the case of the lime that is actually required to neutralize the soil acids.

Sir Bernard Greenwell's Land Reclamation.

One of the most interesting farming enterprises in the eastern counties at the present time is the reclamation of poor sandy soil now being done in East Suffolk by Sir Bernard Greenwell. He has acquired, in the Butley region, 8,000 acres of land, including 3,000 acres of arable, which was either derelict or nearly so, and by applying about 5 tons of chalk per acre, together with intensive cultivations, he has been able to bring it into effective production and to make it carry the stock which will still further raise the soil fertility. Until Sir Bernard began his work it was supposed that this bracken-covered land was unfit for agriculture, and it was therefore being bought up by the Forestry Commission for planting. He has shown, however, that the process of reclamation is relatively simple and that there is no justification for

letting the land lapse to forestry. The chief crops grown are, in order of area, barley, sugar beet, oats, various folding crops for sheep, wheat, seeds, red clover, the kales, and a number of others. The live stock includes 1,800 sheep, 1,300 pigs, nearly 700 cattle and 85 horses. Besides cash crops such as sugar beet, wheat and various seeds, much milk is produced. Vegetables, particularly carrots, do well; high quality seed can be obtained, while fruit, especially bush fruit, flourishes. The land is in the same district as Tunstall, and Sir Bernard is obtaining, on a large scale, the same kind of results as Mr. Oldershaw has obtained on his plots. The region appears to have great possibilities and, even allowing for the fact that this year (1937) has been emphatically a light-land year, the crops at the time of the writer's last visit (late July) were looking remarkably well. The experiment will be watched with interest, for it is rare that the satisfaction of reclaiming waste land can be enjoyed in so pleasant a district and with so good a climate as here; more usually reclamation has to be done under wet and rather depressing regions. It is to be hoped that other landowners will follow Sir Bernard's example and bring back more land to agricultural use. Formerly the area in question was in good repute and very productive, as is shown by the large farm houses and the even larger barns.

Grassland.

Two important events in relation to grassland in this country have been the announcement of the Government scheme for subsidizing the purchase of basic slag (the refund being one-quarter the cost) and the holding of the Fourth International Grassland Congress at Aberystwyth in July, 1937.

A full account of the work of the Basic Slag Committee of the Ministry of Agriculture has been given in previous Reports. It is sufficient here to say that the co-operation of steel makers, slag grinders and distributors, and agriculturists on this Committee has enabled things to be done that would otherwise have been impossible. The broad result of the work has been to prove the superiority of high-soluble slag (80 per cent. soluble) and thus to encourage steel makers to produce this type of slag wherever the exigencies of the various processes allow it to be done; slag grinders are grinding by preference the high-soluble material. A great mass of information is now available as to the best ways of using the available supplies.

The Grassland Conference brought together a large number of people from various parts of the world and summaries of their papers have now appeared in the form of abstracts (Ref. 65).

In his presidential address Professor R. G. Stapledon stated that the most hopeful way of studying grassland problems was by means of regional surveys as used by the Aberystwyth workers

in their treatment of the grasslands of Wales. The procedure was to map, classify and plan on the basis of natural regions, adapting to each the correct type of implements, fertilizers and especially the correct strains of seeds. The breeding of herbage plants should, he said, be carried out in the areas for which they were intended, and interchange of genes (by crossing) between different countries was more likely to be fruitful than interchange of seeds. Of the many factors concerned in the making of useful grassland the animal is by far the most important, being followed by the leguminous plant. Improvement in many instances consists in setting up soil conditions under which a suitable legume will grow, and then adopting a system of management to favour the legume as well as the grazing animal. There follows the possibility of growing superior herbage plants that had never succeeded before. The easiest way of improving much of the poor grassland of the country is to plough out and re-seed. The herbage should be grazed hard before breaking up, with a view to laying up a store of organic manure or "stock nitrogen" in the soil. After ploughing, a dressing of lime is given, when the accumulated fertility is in a form to be cashed through some arable crop; alternatively the land may immediately be put back into still better pasture. Another point of the greatest importance is the production of out-of-season keep. Much has been done lately to conserve summer grass, in dried form, for winter feeding, but some progress has also been made in growing fresh grass of good quality for use between December and March. It is a case of species and management. Choosing winter-green strains of plants, the grass is heavily manured through the growing stock, is further assisted by the application of a little artificial nitrogen, and is rested from the end of summer onwards. In this way the Aberystwyth workers have secured, on occasions, as much as 1½ tons of dry matter per acre, containing from 14 to 20 per cent. of crude protein, between Christmas and the end of March. Here again young leys offer more possibilities than permanent pasture.

Conversion of Woodland into Grassland.

When the heavy soils began to go out of arable cultivation, in the second part of the 19th century, the art of laying land down to grass was not well understood. Some of the fields tumbled down to grass, while others were planted with trees to serve as game preserves or for other purposes. It not infrequently happens nowadays that the trees have to be felled in order to raise money, and the question then arises, what shall be done with the land? It can, of course, be left for natural regeneration, or it can be planted in accordance with good modern forestry practice. There is, however, a third possibility: to convert it into grassland.

All three methods will shortly be tested at Rothamsted. A wood was included in the Rothamsted estate which was recently purchased by the Trustees, but the trees were retained by the vendor: these are now being felled and the land will then be divided into three parts to be treated respectively in the three ways mentioned above.

A good deal of experience on this subject has been acquired in New Zealand, where some 14 million acres of forest have been felled, of which about 12 million acres have been more or less successfully converted into grassland. The method is to burn the branches and other unusable timber on the land and then to sow a grass mixture. Fences are of course erected so as to control the stocking. A suitable scheme of management has been worked out and was described at the Grassland Conference (Ref. 66).

The need for Lime and Phosphate in Grassland Management.

This subject was discussed at the Grassland Conference by J. A. Hanley (Ref. 67) who points out that in spite of numerous demonstrations on the use of lime and phosphates in grassland improvement, deficiency in those two substances is still the outstanding trouble with most of the grassland in England and Wales.

Lime deficiency occurs chiefly on light soils and in industrial districts where a smoke-polluted atmosphere emphasizes the effects of soil acidity. Grassland in such areas has a very restricted flora and, when it is ploughed out, difficulties with the characteristic "mat" and the restricted choice of arable crops, make the re-establishment of good grass almost impossible unless heavy dressings of lime are applied. Phosphates have little or no effect until lime has been given. Wild white clover will tolerate a wide range of soil acidity, but desirable grasses such as perennial ryegrass will not.

In England, the soils most affected by soil acidity are those derived from millstone grit, the coal measures, the new red sandstone and glacial sands and gravels. In the north of England where farms on boulder clay soils, less acid than those enumerated above, have recently turned to dairying, lime deficiency has set a limit to pasture improvement. While lime will improve the herbage on acid soils whatever the management, a phosphatic fertilizer will give results only where pasture management is reasonably good.

Phosphate deficiency is the limiting factor over a very wide area and a wide range of soils, especially limestones and calcareous and non-calcareous clays, when under grass.

The low recovery in the herbage of the added phosphate is rather remarkable. At Cockle Park, where the effects of slag

have been very striking, only about 10 per cent. of the added phosphate has got into the herbage.[1] Large areas of rough grazings in the north, grazings which fell away to grass during the period of low prices for agricultural produce, suffer mainly from phosphate deficiency; typical land of this character, recently ploughed out with a view to grassland improvement, gave no root crop at all unless phosphate was applied.

In some other countries mineral deficiency gives rise to very obvious disease symptoms in grazing animals; in Great Britain such extreme conditions apparently do not exist. Nevertheless evidence of mineral deficiency as a contributory cause of disease in live stock, especially sheep, is accumulating; unimproved rough grazings on the Cheviots, where such diseases are very rife, have been found to be very deficient in phosphate.

There are many similarities in agricultural conditions between Great Britain and the Eastern United States, and it was interesting to learn at the Grassland Congress that the poor pastures of Connecticut are much improved by additions of phosphate and of lime. As in this country, wild white clover was encouraged by the treatment. Nitrogenous fertilizers increased the growth of herbage, but the general economic result was not as good as when phosphate and lime alone were given (Ref. 68). The various effects of fertilizers on the composition of the flora of grassland were discussed at the Grassland Conference (Ref. 69).

Manurial Trials on Pasture.

All experimenters are familiar with the difficulty of carrying out manurial trials on pasture land: the effect of management is so great that it can almost entirely mask the effects of the manures, and in any case, unless the management is on strictly practical lines, the results can afford but little guidance to the farmers. The difficulties have not been completely overcome: they were discussed at the Grassland Conference, where methods of dealing with them were described (Ref. 70).

The Neglected Condition of much Grassland.

A survey of the grassland of Hertfordshire made by R. G. Ferguson (Ref. 71) showed that some 18 per cent. of the land needed drainage, 36 per cent. was very acid and more than 60 per cent. of it, especially the London clay area, would probably have responded to lime. The newer pastures, however, seemed less in need of lime than the older ones. Along with acidity goes the tendency for the land to become covered with a "mat," which prevents the development of wild white clover and of the better grasses. Fifty to 60 per cent. of the land received no manure

[1] In some of the Rothamsted grassland experiments higher recoveries have been obtained, but never more than 25 per cent.

at all, 24 per cent. received potash and phosphates, and 8 per cent. phosphate only: the rest had some dung. The most prevalent weeds were of the broad-leaved type, but thistles and buttercups were also numerous. Acid pastures consisted largely of Agrostis, Yorkshire Fog and Sheep's Fescue, none of them of much value. Only a few farmers practised rotational grazing.

Improvement of Hill Pasture: The Cahn Hill Experiments.

The well known Cahn Hill experiments on the improvement of hill grazings have been again described by Moses Griffith (Ref. 72). On the drier slopes of hilly land in Wales, even at an altitude of 1,400 feet, swards of *Molinia, Nardus* and bent have been converted into pastures containing at least 20 per cent. of wild white clover and fair percentages of crested dogstail, perennial ryegrass, cocksfoot and Yorkshire fog.

Marshy land can, without the necessity for expensive drainage, be converted into quite good grazing by cultivation, the sowing of cleanings, and manuring, accompanied by the heavy grazing and close mowing of the resulting sward. Bracken-infested land can be greatly improved by ploughing, manuring and seeding, with twice-yearly cutting of the bracken—at the end of June and in late August.

Three operations are necessary to achieve these results, and the omission of any one of them greatly reduces the degree of success :—

1. Drastic cultivation, either by severe harrowing, rotary cultivation or ploughing.

2. Manuring with not less than 6 cwt. per acre of 32 per cent. basic slag, of high citric solubility, together with 1 cwt. per acre of nitro-chalk (or their equivalents of phosphate and nitrogen in other suitable forms).

3. The sowing of "seeds" mixtures made up of wild white clover (usually in the form of cleanings), crested dogstail, indigenous ryegrass and, if the soil be very poor, Yorkshire fog. Under good conditions the mixture should be supplemented with pedigree seeds of ryegrass and cocksfoot.

The improved swards obtained have been found capable of carrying a sheep stock (Welsh Mountain breed) of approximately four ewes and four lambs per acre in summer, about 60 per cent. of the lambs being fit for slaughter off their dams. This compares with a summer capacity, before improvement, of one ewe and one store lamb per acre. In winter, when the old sward carried a very low head of stock (certainly not in excess of one ewe per four acres) two ewes per acre can now be carried from October to May.

Good crops of rape and turnips can be grown up to altitudes

of 1,350 feet, and they will fatten as many as 12 or 15 lambs per acre, giving total live-weight increases up to 95 lb. per acre.

Lambs and tegs can be successfully wintered by allowing them a two-hour period daily on winter-green grasses such as timothy and Italian ryegrass, the remainder of the 24 hours being spent on poor pasture.

The improved swards must be rested for six to eight weeks at some period during the growing season, but they must also be grazed very hard at certain periods of the year to prevent the excessive formation of flower heads, otherwise the quality falls off.

Young cattle over nine months old can be successfully grazed on the hills during the summer months.

Improvement of Grazing by means of Poultry.

Another way of improving poor pasture is by the folding of poultry, either light folding or close folding in pens. The effects have been examined by A. W. Ling and W. R. Muir (Ref. 73), who give examples of the striking changes in the appearance of the herbage and in its chemical composition. An old pasture containing up to 60 per cent. of fine-leaved fescues, mostly tufted or matted, was in twelve months converted into a good second-grade cow pasture containing a useful mixture of grasses and clovers; the protein in the herbage was increased from 11 or 12 per cent. up to 15, 18 and, in one case, even 22 per cent., and both the lime- and the phosphate-content of the herbage increased. Penning the poultry also improved the herbage, especially when cows, or cows and sheep, grazed it, and helped to maintain a more uniform sward by preventing the development of fibrous tufts.

Wherever it is proposed to use poultry for the improvement of poor acid pasture, a full dressing of lime or limestone should be given first; indeed it seems possible that under the influence of poultry, lime is lost rapidly from the soil. Where poultry have long been penned on the land the amount of available phosphoric acid increases considerably, and the authors suggest that conditions might arise similar to those in the potato-sick soils described by Blenkinsop (Ref. 74) in Devon and Cornwall, where an excessive phosphate supply proved harmful until it was balanced by supplying sufficient potash. If such cases are found, the remedy would be either to make a heavy application of potash or else to plough up the pasture, apply potash and re-seed.

Under light grazing with poultry (25 birds to the acre) wild white clover is encouraged, but under an intensive system with 200–400 birds per acre, the wild white clover is eaten out.

An interesting discussion on the influence of soil on egg quality has been published by R. Coles (Ref. 75). The distribution

of egg quality in England and Wales, which is set out on a map, appears to be related both to the climate and soil. The data are insufficient to allow of any definite conclusions, but it would seem that the chalk areas do not give the best quality eggs or egg shells. The subject is interesting, and more information could usefully be collected.

Improvement of Lowland Pastures and Meadows.

Improvement by Fertilizer.

When a fertilizer is applied to grassland it causes the grass to grow, just as it would any other crop; but it also increases the growth of the weeds and the clovers, and these various plants do not all grow to the same extent. Some do better than others and, in growing, they tend to crowd out those that have benefited less. If the same kind of manuring is continued for a period of years, and if the general treatment remains substantially the same, the herbage adapts itself to the treatment, and settles down to a type which remains much the same so long as the manuring is kept unchanged. This general rule holds both for meadow and for pasture.

Meadow Land.

The park grass plots at Rothamsted, which are laid up for hay each year, afford the best illustration of the effect of manuring on yield and quality of hay. To begin with the herbage was fairly uniform over the whole field. After a time, however, the different plots began to look different, according to their manurial treatment, and now the visitor walking over them finds it difficult to believe that there has been no re-seeding, so different have the plots become. On the unmanured plots nothing grows very well, and there is sufficient bare space to allow any seedling to make some growth. Plants that cannot stand vigorous competition, such as quaking grass (*Briza media*), birdsfoot trefoil (*Lotus corniculatus*), oxeye daisy and cowslip can all survive. These plants are useful indicators of poverty; it is safe to say that where they are found nothing grows vigorously enough to crowd them out. Plots manured with potash and phosphate, but no nitrogen, also carry many species of more luxuriant growth, with a large proportion of leguminous plants. With heavy nitrogen applications the yield of hay greatly increases but the number of species is greatly reduced. The behaviour of the groups of plants depends upon the form in which the nitrogen is given. With ammonium sulphate, leguminous and miscellaneous plants have practically disappeared. With heavy dressings of nitrate of soda some weeds, as dandelions, are abundant, and with light dressings (without any additions of minerals) a very weedy herbage is produced, containing a fair proportion of leguminous plants.

Within the main outlines, however, the botanical composition of the herbage varies greatly from year to year. With complete fertilizers, including nitrogen, potash and phosphate, the relative proportions of the three main groups of species, *i.e.*, grasses, legumes and miscellaneous plants, are not usually much affected by season, though the individual species do vary; but with one-sided fertilizers, and on unmanured areas, wide year-to-year fluctuations occur in the percentage of these groups.

The variations of individual species occur on all plots. They may be caused by direct or indirect response to season, and are much influenced by the type of manuring. It is often difficult to say whether a marked increase or decrease of a species, in a given year, is due to climatic conditions that have favoured or proved detrimental to that particular species or whether the change is due to greater or less vigorous competition from the other species present. In some cases, especially with organic fertilizers, the main groups and also certain species (as foxtail, sweet vernal and cocksfoot) show a tendency to rhythmic changes, rising and falling over periods of years. In other cases the fluctuations are more abrupt and irregular, being sometimes exaggerated in the presence of lime.

The response to liming is most marked on liberally manured plots, particularly those receiving sulphate of ammonia. Even in the winter these limed areas stand out clearly, whereas much less difference is seen on poorly manured plots and on those receiving nitrate of soda. With complete artificials including sulphate of ammonia, liming has completely changed the balance of the botanical composition within the group of grasses, though it has not re-introduced weeds or leguminous plants. Individual species usually respond to lime at once, but under certain soil conditions a delay may occur until a second dressing has been given. Apparently the maximum effect of liming is reached within a few years from the first application, after which time fluctuations with season may again set in (Ref. 76).

The succession of a heavy frost in the winter 1928–1929 and a spring drought in 1929 killed the herbage on the unlimed halves of plots receiving sulphate of ammonia, potash and phosphate, but not on the limed halves. The herbage had included Yorkshire fog (*Holcus lanatus*) and four other grasses —sheep's fescue (*Festuca ovina*), sweet vernal (*Anthoxanthum odoratum*), tall oat grass (*Arrhenatherum avenaceum*) and meadow foxtail (*Alopecurus pratensis*). All were killed, and the only one that came back was the Yorkshire fog, so that the herbage became practically a pure culture of this grass. On the plot that receives no potash the Yorkshire fog has, however, not been quite so vigorous, and some of the other grasses are now again getting a footing.

The best yields of good quality hay are obtained when farmyard manure is given about every four or five years, with some further dressing in between; or when complete fertilizers, including nitrate of soda, are applied; or, if sulphate of ammonia is used, where lime also is given.

Grazing Land.

On grazing land the herbage is, or should be, kept down by proper grazing and, while the same general rules hold about the manures, there is the important difference that the low-growing species are not overshadowed by the tall growth of hay. In consequence plants like wild white clover have their chance. If soluble phosphate is used, the wild white clover can develop considerably: if, however, nitrogenous manures, especially sulphate of ammonia, are used, the grasses are increased to a greater extent.

In the experiments carried out by the Rothamsted staff under the ægis of the Ministry of Agriculture Basic Slag Committee, high-soluble slag has been compared with low-soluble slag, with mineral phosphate, and with superphosphate as phosphatic fertilizer for grassland. The experiments were made at a number of centres covering a wide range of conditions of soil fertility, as may be seen from the fact that the average yields over four years varied from 6 cwt. of dry hay per acre on the poor soil at Cockle Park to over 30 cwt. per acre at three of the centres. As was to be expected, the responses to phosphate were relatively small at the centres which gave high yields without manure. High-soluble slag and superphosphate gave similar results throughout; superphosphate gave the greater effect in the first season but the high-soluble slag caught up in total yield over four seasons. Low-soluble slag was far inferior at all centres where responses were obtained. Mineral phosphate was as effective as the high-soluble slag and superphosphate on the acid soils, but was even less effective than the low-soluble slag on the two neutral soils. The figures for the percentage recovery of the added phosphoric acid showed a much more consistent trend than the yields. Except from the very poor Cockle Park soil the recovery of phosphoric acid from the high-soluble slag and superphosphate fell within the range 13–23 per cent., and at no centre was there any appreciable difference between these two materials. On the four acid soils the recoveries from mineral phosphate were similar to those from the two more soluble fertilizers, and far higher than those from low-soluble slag. These experiments show that when hay trials are supplemented by chemical analyses to determine the actual uptake of the added nutrient, they are capable of giving reliable and

consistent data, even though the yield results may show only comparatively small effects of treatment.

During the last few years certain steel-works have succeeded in producing a new class of medium-soluble slags in place of low-soluble slags, and it became necessary to ascertain whether these new materials were more effective as fertilizers. The main field experiments were made on swedes in Scotland and are still in progress, but mention may be made here of a series of experiments conducted at Rothamsted on perennial ryegrass grown in pots in an artificial sand-bentonite mixture.

Percentage recovery of added Phosphoric Acid from Basic Slags in Pot Culture Experiments on Perennial Ryegrass, 1934–5.

Percentage citric acid solubility of slag	23	24	30	42	44	53	61	66	89	93	96
Milligrams phosphoric acid in crop, per pot. 250 mgs. total P_2O_5 added	64	59	66	87	105	106	128	135	160	174	179
Milligrams phosphoric acid in crop, per pot. 500 mgs. total P_2O_5 added	92	95	119	156	159	189	211	229	286	292	303

Over a wide range of slags, in single and double dressings, the percentage recovery of the phosphoric acid was almost a constant fraction of the percentage citric-acid solubility of the phosphoric acid in the slags. Under these highly simplified conditions the conventional citric acid method thus serves as a reasonably satisfactory measure of the availability of the phosphoric acid in basic slags. These results are in harmony with those of all the replicated field experiments on grassland already mentioned.

The Breaking-up of Grassland.

This question has recently been fully discussed by A. W. Oldershaw (Ref. 77), who has collected much useful information in regard to the best ways of dealing with the cultivation difficulties that arise when old grassland is converted into arable. Trouble is caused both by weeds and by the mat of undecayed vegetable matter. Of the cereals, oats make the most suitable first crop: wheat is more difficult, and barley is the least suitable.

Both in Wales and in Derbyshire good results have been obtained by sowing a grass seeds mixture immediately, *i.e.*, without any interval under arable crops but using rape as a cover crop; after a few years of grass, and treatment with lime and phosphate, the land can be broken up again and is then in much better condition for growing arable crops.

If the climate is dry and the soil not acid, field peas or beans do well on broken-up grassland, beans being better on the heavier soils. Vetches, and silage mixtures containing vetches, also do well.

Where farmyard manure is available potatoes could be grown as a first crop, but good manuring must be given. On rich land mangolds, sugar beet, cabbage and kale are very suitable.

Modern Field Experiments.

One of the most important developments in recent years has been the great improvement in the design of field experiments, a result of the introduction of statistical methods. The new designs are discussed in a paper, in the last issue of the *Journal* of this Society, by E. M. Crowther (Ref. 78), who shows the various types of experiments now in use and their relative advantages. A fuller account is given by F. Yates (Ref. 79). The days have gone by when the old-fashioned single plots could be laid down, and no one should now undertake field experiments unless he is prepared to do the work properly.

Crop Growth without Soil.

There has been much comment in the press about a method now under experiment in California of growing crops without soil. As this is due to Prof. W. F. Gericke of the University of California, it must be taken seriously, and not classed with the numerous "stunts" that periodically attract attention among townspeople and provide mild amusement for the countryman. It is well known in laboratories that many plants can be grown to perfection in water containing the proper nutrients, and require no soil at all: these "water cultures" can be seen at any time during the growing season at Rothamsted or other places where such work is done. The yields are high and there is, of course, no cultivation. There are, however, other difficulties. Prof. Gericke had the idea of putting this method into large-scale practice. His first paper (Ref. 80) was published in 1929 and since then there has been little publication (Ref. 81). Prof. Gericke is wisely not rushing into print, but is getting on with the work, and he informs me that the practical applications are being worked out. In the late summer of 1935 a number of large growers produced and sold vegetables and flowers grown in water cultures. It is claimed that far more produce can be obtained per unit area than where soil is used. The method is obviously more interesting to glasshouse growers than to farmers or outdoor market gardeners, but it is worth close watching.

Agricultural Surveys.

A considerable amount of survey work is at present being done in this country by the staffs of the County or Provincial Organizations, by Departments of Agricultural Economics, and also by students of Geography. At present much of the work remains unpublished and in consequence is not generally available.

This is unfortunate, as a good deal of it is of considerable value. The Farm Economics Branch of the Cambridge University Department of Agriculture has continued with its studies of the economic position of East Anglian farmers (Ref. 82). Dr. Catherine P. Snodgrass has recently issued an account of the agricultural geography of Lanarkshire, which contains much interesting information not easily found elsewhere (Ref. 83).

Empire Agriculture.

Effect of Salt on Growing Crops.

As the percentage of salt in the soil increases, so the crops find more and more difficulty in surviving. They vary, however, in their susceptibility, and some will stand more salt than others. A list has recently been drawn up setting out American experience (Ref. 84). The deterioration that sets in with grape vines in Palestine, with increasing salt content, has been studied. It is shown the grape itself absorbs salt and that this affects the processes going on in the fruit; the percentage of sugar falls and that of acid rises as the quantity of salt increases (Ref. 85).

Nitrogen Manures in the Tropics.

Reference has already been made to the green manuring experiments in Nigeria and the remarkable result that the yields of the following maize crop were just as good whether the green manure was ploughed in as such or spread on the ground and burnt. This raises the question how far nitrogenous manuring is necessary in tropical conditions.

A considerable number of field trials show that nitrogenous fertilizers are beneficial in hot countries just as they are in cold ones, but only so long as sufficient soil moisture is present. In dry conditions the fertilizers cannot act, and the real problem is how dry differ from moist regions in regard to nitrogen requirements of their soils. In humid regions it is necessary to add nitrogenous fertilizers in order to make up for the wastage which occurs through leaching. In arid regions leaching is inconsiderable and there are numerous instances of the failure of added nitrogen to increase the crops. The subject is discussed by the writer in the last edition of "Soil Conditions and Plant Growth" (Ref. 86), and also in a recent paper by P. C. L. Oberholzer (Ref. 87). It is possible that under dry conditions bacterial fixation goes on at a rate sufficient to supply all the nitrogen compounds necessary.

The bacterial processes have been frequently studied, some of the latest work having been done in India by T. R. Bhaskaran and V. Subrahmanyan (Ref. 88).

Manurial and Cultivation Experiments on Tropical Crops.

(1) Cotton.

Some of the most comprehensive manurial and cultivation experiments yet made on cotton have been carried out by Frank Crowther (Ref. 89) in Egypt, under the joint agricultural research scheme of the Royal Agricultural Society of Egypt and Imperial Chemical Industries, Ltd. These experiments are concerned with the effects of variety, spacing, nitrogenous and phosphatic manuring and water supply on the growth of the crop. They are of the modern complex type, involving large numbers of plots, and bring out clearly the large amount of information that can be obtained from properly designed field trials. It is well known that different varieties respond differently to fertilizers; these experiments give a measure of the differences between one variety and another. The old variety, Sakelerides, common some 15 or 20 years ago, did not respond to nitrogenous fertilizer, and so gave the impression that cotton under Egyptian conditions needs no added nitrogen. In recent years, however, "Sakel" has been largely replaced throughout the middle and south Delta by Ashmouni, and to a less extent by Giza 7 and Maarad. All these varieties respond well to nitrogenous manure so that a complete change in manurial practice has been necessitated by this change of variety.

The percentage recovery of nitrogen from nitro-chalk by the cotton crop was about 50 per cent. at Bahtim and 30 per cent. at Gemmeiza, these figures being of the same order as those commonly obtained elsewhere.

An increased amount of water at each irrigation had, in most cases, no significant effect on yield. At Bahtim, indeed, the heavier watering, when given to cotton receiving nitrogenous dressings, depressed the yield, especially when the spacing was very close. This series of papers should be studied by all concerned with the growth of cotton.

Dr. Crowther has also made experiments on cotton in the Sudan (Ref. 90) where the results naturally differ somewhat from those obtained in Egypt.

An interesting relationship between rainfall and cotton yields, in the Sudan Gezira, has been worked out by E. M. Crowther and Frank Crowther. The cotton is sown in August, but the yield is negatively correlated with the amount of rain falling in May and June, *i.e.*, two to three months before sowing, and this even though the greater part of the season's rainfall comes in July and August. In some areas yields are negatively correlated with these late rainfalls and with the total rainfall in the preceding year. There has been a decline in yield at the oldest trial farm in the area, but this can be largely explained

by a significant increase in total rainfall during the period of cotton cultivation. The rainfall in the Gezira shows a significant seven-year periodicity which is reflected in the cotton yields, durra (millet) exports and recorded famines. It so happens that the first trial of irrigated cotton and the first use of the Sennar Dam coincided with minimal rainfalls on this periodicity. The early promise and rapidly increasing difficulties may well have been due in part to the recurrence of unfavourable weather conditions, and not necessarily to soil deterioration and the increase of pests (Ref. 91).

(2) Tea.

There are two important tea research stations in the Empire, one at Tocklai in Assam, and the other at St. Coombs, Talawakelle. Both are doing admirable work.

The Tea Research Station at Tocklai (Ref. 92) is a private institution maintained by the Indian Tea Growers' Association. The staff is in close touch with the cultivators on the one hand and with the buyers on the other; they are therefore fully cognizant of the market requirements and of the cultivator's difficulties. The samples of tea produced in the experiments are examined by expert buyers in Calcutta and London, who assign marks expressing the opinion of the market about them. The task of keeping in touch with the tea growers is greatly facilitated by the circumstance that they are mainly educated men resident on the plantations, themselves actively concerned in the cultivation of the crop and anxious to improve their practice in every possible way. Further, they are in a position to adopt new methods as soon as their superiority has been proved.

The design of the field experiments is worked out in conjunction with the Rothamsted Station, and the execution is beyond reproach. The ploughing in of a short-term green-manure crop gave no increase in yield, but the long-term green-manure crop *Tephrosia candida* seemed to be better. Both types, while growing, depressed the yield of the tea, but after they were dug in the yield rose. With short-term crops the increase just about balanced the depression, so there was no net advantage; with the longer-term crops the increase was rather more than the depression, so that there was, on the whole, a net gain.

Cultivation beyond what is necessary to keep down weeds fails to increase the crop; the elaborate cultivation, which some of the good growers like to give, has been proved to be unnecessary. Reference to page 219 shows that similar results have been obtained with other crops at Rothamsted and elsewhere. The best economic results were obtained by giving the minimum of cultivation while supplying fertilizer containing 80 lb. of nitrogen per acre; in these circumstances the bushes grew so

well that they touched each other, smothered the weeds, and so rendered further cultivation unnecessary and indeed impossible. The pruning plane is here about 2 feet 6 inches to 3 feet 6 inches in height.

One of the most interesting of the discoveries of the station has been the necessity for an acid reaction of the soil: a pH (hydrogen-ion concentration) value of about 5·6[1] seems to be the most favourable, and at pH 6 difficulties begin to arise. Methods for increasing the degree of acidity are therefore being investigated whenever this is necessary.

There is more good work to record on the control of pests and diseases, and of bacterial infections during curing, but these lie outside the scope of the present Report.

The Ceylon Station has been equally successful in dealing with the tea growers' problems. Dr. T. Eden's investigations on green manure have already been mentioned. The physiologist, F. R. Tubbs, has issued an interesting bulletin (Ref. 93) on the planting and treatment of tea, which will be found useful in Ceylon and in other tea-growing countries.

(3) Rice.

A good deal of rice is grown without manure, or with nitrogenous manure only. Diseases are not uncommon. Some of Dr. Kuilman's observations in Java suggest that one of these, the so-called Mentek disease, is really due to potash deficiency, which could be remedied by supplying potash in the nursery beds where the rice is sown; the plants can take up a full quantity required before they are transplanted (Ref. 94).

Water Requirement of Crops.

This subject is under investigation at many experiment stations of the world, but particularly in the dry regions such as the arid zone of the United States. I shall refer here only to some results obtained at the Institute of Agricultural Research, Benares Hindu University, by Dr. B. N. Singh (Ref. 95). The amount of water needed by the crop depends on the conditions of growth, and is different for different varieties of the same crop. Some of Dr. Singh's figures for the minimum amount of water required per acre (for both transpiration and soil evaporation) during the whole life cycle of the crop are, in acre inches :—

Sugar beet	45	Wheat	8·5
Tobacco	30·1	Oats	8·1
Cotton	28·3	Barley	7·8
Rice	27·4	Linseed	6·4
Potato	20·4	Peas	5·6
		Mustard	4·34

[1] On the pH scale the figure 7 represents the neutral condition; figures below 7 connote varying degrees of acidity and those over 7 of alkalinity.

Soil Erosion (Ref. 96).

Erosion is a very serious trouble in the dry regions of the Empire and in tropical regions of torrential rainfall. It is brought about by the action either of wind or rain, and it becomes serious when the natural vegetation cover of the soil is removed, as commonly happens when the population either of men or of animals grows large. Damage is caused in three distinct ways :—

(1) The removal of the soil makes the affected area useless and may lead to the scooping out of great ravines;

(2) the soil that is washed away may injure the land on which it is deposited, or may silt up canals and rivers, and so lead to the washing away of river banks or even to floods;

(3) while the vegetation cover is intact the rain water soaks in gradually, accumulating as underground stores or breaking out in springs and steady-flowing streams. With the removal of the vegetation cover, the topsoil loses its porosity and may be removed by erosion, rain can no longer percolate through the soil, but instead runs off as flood water. The stores of underground water are therefore no longer replenished : wells, springs and little streams may all run dry. Floods take their place.

Deforestation, heavy grazing and clean cultivation of sloping land are the commonest causes of erosion. Forest officers are so thoroughly familiar with the dangers of deforestation that they are not likely to allow improper cutting of timber where they have the authority to stop it. Uncontrolled grazing, however, is a much more serious matter, because the mischief is not at first obvious; it may become a very grave danger, and wider powers of control should be given to the officers in the interests of the cattle owners themselves.[1] Goats are generally regarded as the most destructive of all animals, ruining vegetation and soil alike; but buffaloes and cattle may under certain conditions be as bad or worse, especially in damaging trees. Rotational grazing can be so managed as to provide at least as much fodder as unrestricted grazing, without causing deterioration of the herbage or erosion of the soil.

Cultivating up and down the slope of a hill renders the soil liable to very serious erosion. So also does the "clean" cultivation of tea or coffee plantations on sloping ground. Green cover-crops are, from this point of view, much better; they can be dug in for manure, and so help the bushes to grow till they themselves cover the ground. Against their use it has been argued that they compete with the main crop for the available soil moisture. Most authorities, however, believe that their

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[1] Sir C. C. Trevor reports that in the Etawats region such a good grass cover developed after closing to grazing that erosion entirely ceased. Many other instances are on record.

advantages in preventing erosion far outweigh their disadvantages.

Both in wet and dry regions the remedy for erosion is based on the same principle : the reduction of the velocity and of the amount of water running off the surface. The crucial region is at the top of the slope : if water can once collect here, and start running down, it is very difficult to check. Several devices can be adopted.

(1) Afforestation of the top slopes ; this is one of the surest methods where it is practicable.

(2) Putting the upper slopes into grass, or, to prevent sheet or wind erosion, alternate grass and arable strips ; the grass affords effective protection provided always that excessive grazing is prevented.

(3) Contour-furrowing of grazing land, and ploughing of arable land along the contour lines instead of across them.

(4) "Bunding" or terracing. Bunding is in India the most usual way of overcoming the difficulty, and it has the advantage not merely of protecting the land against erosion but also of increasing the water supply to the crops. The problem of overgrazing, particularly in the Punjab foothills, has been discussed by R. M. Gorrie (Ref. 97). He suggests several measures which the villagers themselves should adopt in order to develop fodder resources for local live stock and so relieve pressure on the pastures and allow the rotational closure of grazing lands. If at the same time the standard of cultivation is improved in any way tending to conserve soil and reduce run-off, there is a good chance of checking erosion and even of slowly reclaiming the devastated areas.

In the United States, where an enormous amount of work on this subject is being done, it is estimated that about one-third of the cultivated area (which is approximately 18 per cent. of the total area of the country) is liable to erosion, much being grassland. The remedial measures are contour furrowing and the improvement of the sward so as to give a denser cover. Lespedeza and lucerne-grass mixtures have proved useful for re-seeding (Ref. 98).

In South Africa, erosion has reached such alarming proportions that, in the words of General Smuts (reported in the *Rand Daily Mail, 4.6.37*) it is "the biggest problem before the country to-day, bigger than any politics." The Government is taking active measures, by financial assistance, advice, education and research to check the evil, which threatens to undermine South Africa's very existence.

In view of the urgency of the problems involved the Imperial Bureau of Soil Science is preparing an exhaustive review of the present position throughout the world.

IRRIGATION PROBLEMS.

A considerable amount of work on irrigation is being done in different parts of the Empire: this is not the place to discuss it in detail, but I give a description of the work of the Punjab Research Institute, under Dr. E. McKenzie Taylor, which I visited last winter. Much of it is concerned with engineering problems, such as the design of weirs, dams, river training works, etc.; this part I shall omit.

The work that touches most closely on agriculture is that concerned with the movements of the subsoil water and its effects on the soil.

In some areas where it exceeds 10 inches annually, the rainfall accounts for some 80 or 90 per cent. of the variation in the water level during July, August and September. Waterlogging in these areas, when it occurs, must be remedied by drainage of storm water.

The trouble is aggravated by the greater absorption of rain due to the making of bunds, the blocking of drainage resulting from the construction of roads, railways and canals, and the looser condition of the soil due to cultural operations.

Elsewhere, however, the waterlogging is due to seepage, either of irrigation water from the cultivators' fields or from the bed of the canal. A highly interesting piece of work has been done on this subject. The great plain of the Punjab is made up of sand and silt brought down by rivers and filling a basin of much older rocks: the water easily soaks through the sand and silt, but it cannot penetrate the rock and therefore accumulates. The soil surface is fairly level, but the floor of the basin is not: a continuous ridge runs underground across the area and acts as a weir holding up the underground water on its upstream side. In general, it is only on this side that waterlogging occurs: downstream from the ridge there is a sudden drop in the water table. The ridge continues through the United Provinces, but here it runs parallel with the rivers and not across them, so that irrigation has not caused a rise in the water-table. It is, of course, out of the question to survey the depth of the sand and silt by boring through it to the bottom of the basin: fortunately geophysical methods can be used for finding the variations in depth. The contour maps thus constructed show very clearly the areas where waterlogging is liable to occur, and the expectation is borne out in practice.

Experiments indicate that, in certain specified cases which are fortunately of common occurrence, seepage can be greatly reduced by treating the bed of the canal with sodium carbonate: the details have been worked out and, as the cost is not high, the method is now being tested in the Punjab and in Sind.

The rise in the water-table is closely associated with the

appearance of salt or "Thur"; when the water comes to within about 18 feet of the surface any salts present in the soil or the water may begin to appear at the surface.

For some years Dr. McKenzie Taylor had an experimental farm at Chakanwali where he investigated the effects of salt on growing crops and sought for methods of removing it and reclaiming salt-ruined soil. Unfortunately the work was stopped before it was completed, but some useful results were obtained. Soils with pH of less than 8·5 (*i.e.*, only slightly alkaline) and a salt content of less than 0·15 per cent. will grow ordinary crops. When, however, these values are exceeded, wheat suffers. So long as the pH remains below 9·5 additional salts can be economically removed—sodium chloride and sulphate by simple leaching and the growth of rice, which removes salt from the soil and reduces its alkalinity. If the yields of rice are 15 cwt. or more per acre, Senji, or some other leguminous crop, is grown and ploughed in as green manure so as to improve the nitrogen supply to the soil. Reclamation is now complete, and cotton, wheat or sugar cane can be successfully grown. Reclamation is slower when sodium carbonate is present, several crops of rice being required to clear the soil, so that four or five years elapse before any profit is obtained.

If the soils are more strongly alkaline (pH above 9·5) no known method of reclamation is profitable: though where money is no object, treatment with sulphur, gypsum, etc., may be successful, as has been shown in the United States.

Prevention, however, is better than cure. Dr. McKenzie Taylor emphasizes the need of making a proper survey before an irrigation scheme is started or extended. The important factors to determine are the salt contents and pH values of the various layers of the soil profile, and the composition and depth of the subsoil water.

E. John Russell.

Rothamsted Experimental Station.

References.

1. *Fertilizer and Feeding Stuffs Jour.*, 1936, **21**, 603.
2. Gray, A. N. Communicated.
3. International Institute of Agriculture figures.
4. Smalley, H. R. *Jour. American Soc. Agronomy*, 1929, **21**, 269. The figures for phosphoric acid are for Great Britain and Ireland and are given me by Mr. A. N. Gray, Secretary to the Fertilizer Manufacturers' Association, and one of the leading authorities on fertilizer statistics.
5. Krische, P. *Das Kali.*
6. *Rothamsted Annual Report*, 1936, p. 34.
7. Sykes, E. T. *Empire Jour. Expt. Agric.*, 1936, **4**, 152.

8. *Rothamsted Annual Report*, 1936, p. 57. For Scandinavian results see H. Thunaeus *Rept. 5th Internat. Congress Agric. Scheveningen*, 1937.

9. *Rothamsted Annual Report*, 1936, p. 52.

10. Hartley, K. T. *Empire Jour. Expt. Agric.*, 1937, **5**, 254–263.

11. *Rothamsted Annual Report*, 1936, p. 48.

12. Scarlett, R. L. "Cleaning dirty land to produce soil fertility." *Scottish Jour. Agric.*, 1937, **20**, 41.

13. Eden, T. "Salient points in tea cultivation in relationship to green manures and shade trees." *Ceylon Association in London*, Feb., 1937.

14. Faulkner, O. T. *Empire Jour. Expt. Agric.*, 1934, **2**, 93.

15. Doyne, H. C. *Empire Jour. Expt. Agric.*, 1937, **5**, 248.

16. Theron, J J. "Green Manuring." *Univ. Pretoria*, Series, **1**, 33, 1936.

17. Edridge, H. "Problems associated with the changing character of house refuse." *Institute of Public Cleansing Annual Conference*, June, 1937.

18. "Making of poudrette from night-soil." *Dept. Agric., Madras*, Leaflet No. 67.

19. Garner, H. V. "Composts." *Jour. Min. Agric.*, 1937, **44**, p. 330.

20. Eckstein, O., Bruno, A., and Jurrentine, J. W. "Potash deficiency symptoms," Berlin, 1937.

21. (Translated titles.)

"The importance of potash in the development of the root system of plants." *Ernähr. Pflanze*, 33, 1937, (65–73).

"The importance of potash in chlorophyll formation." *Ztschr. Pfl.Kranhk.*, 45, 1935, (449–510).

22. Roach, W. A., and Levy, B. F. G. "Iron shortage chlorosis in the plantation." *Annual Report East Malling Research Station*, 1936, pp. 153–159.

23. Hill, H. "Functional disorders of apples on the tree." *Annual Report East Malling Research Station*, 1936, pp. 180–182.

24. Summarized by W. E. Brenchley in "Deficiency diseases of crop plants." *Jour. Min. Agric.*, 1937, **44**, 116–122.

25. O'Brien, D. G., and Dennis, R. W. G. *Scottish Jour. Agric.*, 1936, **19**, 40–46. T. Rigg, H. O. Askew and E. Chittenden, *New Zealand Jour. Sci. and Tech.*, 1937, **18**, p. 750.

26. O'Brien, D. G., and Dennis, R. W. G. "The place of boron in potato cultivation." *Scottish Farmer*, 1936, Mar. 14th, 364.

27. Burgevin, H., and Foex, E. (Experiments with fodder beets using 12–15 lb. boron per acre in Le Locret and La Mayenne.)

Brioux, C., and Jouis, E. (Experiments dans la Seine inférieure.) *International Inst. for research on Sugar Beet*; 6th meeting, Brussels, 1936.

For fruit trees see H. O. Askew, R. H. K. Thomson and E. B. Kidson, *New Zealand Jour. Sci. and Tech.*, **18**, p. 789.

28. Grimmett, R. E. R., and Shorland, F. B. *New Zealand Jour. Agric.*, 1935, **50**, 367. See also H. O. Askew, *New Zealand Jour. Sci. and Tech.*, 1937, **18**, p. 888, and J. K. Dixon, *ibid.* p. 892.

29. Pearse, H. L. *Jour. Pomology and Hort. Sci.*, 1937, **14**, p. 365.

30. Jensen, P. B. "Die Wuchstheorie." An English translation has been made by G. S. Avery and R. P. Burkholder, 1936.

31. Jensen, P. B. *Zeitschrift Pflanz. Düng.*, 1936, **43A**, 142.

32. Tincker, M. A. H. *Jour. Royal Hort. Soc.*, 1936, **61**, 380, 510.

33. Zimmerman, P. W., and Wilcoxon, F. *Contrib. Boyce Thompson Inst.*, 1935, **7**, 209, and Zimmerman, P. W., and Hitchcock, A. E., *ibid.* 439. See also Williams, S. *Nature*, 1937, June 5th, p. 966.

The method of making the lanoline paste is described by F. Laibach. *Ber. Bot. Gesell*, 1935, **53**.

34. Nehring, K., and Mobius, H. *Zeitschrift Pflanz, Düng.*, 1936, **44B**, 95.

35. Somewhat more pronounced effects were claimed by Iyer, C. H. R., Sidappa, G. S., and Subrahmanyan, V. *Proc. India Acad. Sci.*, 1935, **1**, 381.

36. Harihara Iyer, C. R., Rajagopalan, R., and Subrahmanyan, V. *Proc. Indian Acad. Sci.*, 1935, B. p. 108. The first paper was published in *Current Sci.*, 1933, **2**, 161.

37. Greening, C. B. "The oxidation of soil humus." *Jour. Royal Hort. Soc.*, 1936, **61**, 369–373.

38. Sreenivasan, A. *Mem. Indian Inst. Sci.*, 1936, **3**, 302–309.

39. Achromeiko, A. I. *Zeit. Pflanz. Düng.*, 1934, **34**, A.340.

40. Loehwing, W. F. "Root interactions of plants." *Botan. Review*, 1937, **4**, 195–239.

41. Bond, G. *Nature*, 1937, **139**, 675.

42. Breazeale, J. F. "The injurious after effects of sorghum." *Jour. Amer. Soc. Agron.*, 1924, **16**, 689.

Hawkins, R. S. "The deleterious effect of sorghum on the soil and other succeeding crops." *Jour. Amer. Soc. Agron.*, 1925, **17**, 91.

43. Ayyar, V., Ramanatha, Kasinath, S., and Balakrishnan, M. R. *Current Sci.*, 1935, **4**, 99. *Madras Agric. Jour.*, 1936, **24**, 355.

44. Achromeiko, A. I. *Zeit. Pflanz. Düng.*, 1936, **42**, 156–186.

45. Samuel, G. "Whiteheads or Take-All in wheat." *Jour. Min. Agric.*, 1937, **44**, 231–241.

46. Garrett, S. D. "Soil conditions and the Take-All diseases of wheat." *Ann. Appl. Biol.*, 1936, **23**, pp. 667–699.

47. Garrett, S. D. *Empire Jour. Expt. Agric.*, 1937, **5**, 189–196.

48. Carpenter, C. W. *Hawaii Plant Res.*, 1934, **38**, 279.

49. Vanterpool, T. C., *Canada Jour. Res.*, 1935, **13**, C.220.

50. Sharples, A. "Diseases and pests of the rubber tree," MacMillan, 1936.

51. Millard, W. A., and Taylor, C. B. *Ann. Appl. Biol.*, 1927, **14**, 202.

52. King, C. J., Hope, C., and Eaton, E. D. *Jour. Agric. Res.*, 1934, **49**, 1093.

53. Fellows, H. *Phytopathology*, 1929, **19**, 103.

54. Reinking, O. A. *Zbl. Bakt. Abt 2*, 1935, **91**, 243.

55. Andrews, F. W. *Empire Jour. Expt. Agric.*, 1937, **5**, 204.

56. Ladell, W. R. S. *Ann. Appl. Biol.*, 1936, **23**, 862.

57. Singh, Jagjiwan. "Soil fungi and actinomycetes in relation to manurial treatment, season and crop." *Ann. Appl. Biol.*, 1937, **24**. 154.

58. Fritsch, F. E. "The role of terrestrial algæ in nature." *Essays in Geobotany in honour of William Albert Satchell. California Univ. Press*, 1936.

59. *Rothamsted Annual Report*, 1936.

60. Keen, B. A., and Russell, E. W. *Jour. Royal Agric. Soc., England*, 1937.

61. *Rothamsted Annual Report*, 1936, p. 46.

62. Keen, B. A. *Jour. Min. Agric.*, 1936, **43**, 521.

63. Quarrell, C. P. *Jour. Min. Agric.*, 1937, **43**, 446.

64. Russell, E. J. "The preservation of soil fertility." *Farmer and Stockbreeder*, 1937, July 6th, p. 1645.

65. 4th Int. Grassland Congress, 1937, Aberystwyth. Full report is expected later.

66. Levy, E. Bruce. 4th Int. Grassland Congress, Aber., 1937. Abstracts, p. 8.

67. Hanley, J. A. 4th Int. Grassland Congress, Aber., 1937. Abstracts, p. 55.

68. Brown, B. A. 4th Int. Grassland Congress, Aber., 1937. Abstracts, p. 59.

69. Konig, F. 4th Int. Grassland Congress, Aber., 1937. Abstracts, p, 74.

70. Biederbeck, H. 4th Int. Grassland Conf., p. 57.

71. Ferguson, R. G. *Jour. Min. Agric.*, 1937, **44**, 335.

72. Griffith, Moses. *Jour. Royal Agric. Soc., England*, 1936, **97**, 33.

73. Ling, A. W., and Muir, W. R. *Jour. Min. Agric.*, 1937, **43**, 1056.

74. Blenkinsop, A. *Jour. Min. Agric.*, 1935, **41**, 1187.

75. Coles, R. *Jour. Min. Agric.*, 1936, **43**, 317.

76. Brenchley, W. E. "The effect of light and heavy dressings of lime on grassland." *Jour. Min. Agric.*, 1925, **32**, 504–512. "The varying effect of lime on grassland with different schemes of manuring." *Jour. Min. Agric.*, 1930, **37**, 663–673.

77. Oldershaw, A. W. *Jour. Min. Agric.*, 1937, **44**, 25.

78. Crowther, E. M. *Jour. Royal Agric. Soc., England*, 1936, **97**, 54.

79. Yates, F. "The design and analysis of factorial experiments." *Imperial Bureau of Soil Science, Tech. Comm.*, 1937, No. 35.

80. Gericke, W. F. *Amer. Jour. Botany*, 1929, **16**, 862.

81. A short note was published in *Science*, 1937, **85**, 177, 178, giving the name "Hydroponics" (water labour) to the new methods, but no details as to procedure.

82. Univ. of Cambridge Dept. of Agric. *Farm Economics Branch Report*, No. 24, 1937.

83. Snodgrass, Catherine P. "Lanarkshire: the agricultural geography of a Scottish county." *The Scottish Geographical Magazine*, 1937, **53**, 176.

84. Kearney, T. H., and Scofield, C. S. *U.S. Dept. Agric.*, 1936, Circular No. 404.

85. Ravikobitch, S., and Bidner, N. *Empire Jour. Expt. Agric.*, 1937, **5**, 197–203.

86. Russell, E. J. *Soil conditions and plant growth*, 7th edition, 1936. Longmans Green & Co., pp. 391, 403.

87. Oberholzer, P. C. J. *Soil Sci.*, 1936, **42**, 359.

88. Bhaskaran, T. R., and Subrahmanyan, V. "Some new aspects of the mechanism of nitrogen fixation in the soil." *Proceedings of National Institute of Sci. of India*, 1937, 3, 163.

89. Crowther, Frank, and Others. *Royal Agric. Soc., Egypt, Bulletins* 22–26. Technical Section.

Bulletin, No. 22.—"Experiments in Egypt on the interaction of factors in crop growth. I. A preliminary investigation of the inter-relation of variety, spacing, nitrogen and water-supply, with reference to yields of cotton."

Bulletin, No. 24.—"Experiments in Egypt on the interaction of factors in crop growth. 2A. Residual effects of nitrogenous manuring and spacing of the cotton crop on the following wheat crop. 2B. Inter-relation of nitrogenous manuring, variety and spacing for the wheat crop."

Bulletin, No. 25.—"Experiments in Egypt on the interaction of factors in crop growth. 3. The effects of variety, spacing, nitrogen and water supply on the development of the cotton plant and the rate of its absorption of nitrogenous fertilizer."

Bulletin, No. 26.—"Experiments in Egypt on the interaction of factors in crop growth. 4. Nitrogenous and phosphatic manuring of cotton and their relation to variety and spacing. A summary of the results is given in 'Multiple-factor experiments on the manuring of cotton in Egypt.'" *Empire Jour. Expt. Agric.*, 1937, 5, 169.

90. Lambert, A. R., and Crowther, Frank. *Empire Jour. Expt. Agric.*, 1935, 3, 289.

For a discussion of the scientific problems involved see Crowther, Frank. "Studies of the growth analysis of the cotton plant under irrigation in the Sudan." *Annals of Botany*, 1934, Vol. 48, 877. *Empire Jour. Expt. Agric.*, 1935, 3, 276.

91. Crowther, Frank. *Proceedings of the Royal Society*, 1935, 118, 343. (Series B.)

92. India Tea Association Scientific Department. *Tocklai Expt. Station.*

93. Tubbs, F. R. "Investigations on the planting, pruning and plucking of the tea bush." *The Tea Research Institute of Ceylon, Bulletin No.* 15.

94. Kuilman, L. W. *Korte Meded. Algem. Proef. Stat. Voor den Landbouw*, 1936, No. 20; also *Landbouw*, 1935–6, 11, 77.

95. Singh, B. N., and Others. "Investigations into the water requirements of crop plants." *Proceedings of the Indian Academy of Sci.*, 1935, 1, B.471.

"Growth and water requirements of crop plants in relation to soil moisture." *Proceedings of the Indian Academy of Sci.*, 1936, 4, B.376.

96. For a summary of soil erosion research, see *Imp. Bur. Soil Sci., Tech. Communication*, No. 28. For a careful discussion of the South Africa problem see Leppan, H. D. "The organization of agriculture with applications to S. Africa, 1936." *Central News Agency, S. Africa. Univ. Pretoria Agric. Pub.* Series I. No. 37, 1936.

97. Gorrie, R. M. "The foothills grazing problem in India." *Herbage Reviews*, 1936, 5, 74–78.

98. Enlow, R. C. 4th Int. Grassland Conf., Aberystwyth, 1937. Abstracts, p. 2.

CONTEMPORARY AGRICULTURAL LAW.

I FEAR that my readers may find this article rather dull reading. The fault is not mine.

I suppose that few folk would choose the study of agricultural law as an after-dinner recreation, and that anyone who sets out to read this article must be desirous of finding out what are the legal changes affecting agriculture, whether this is his business or his hobby. Unhappily, it is not easy to give in simple words any useful indication of such changes.

During the period under review few cases of interest to agriculturists have been decided in the Law Courts. On the other hand, several statutes of importance have received the Royal Assent; but unfortunately they are somewhat typical of modern legislation.

It would not be proper in this article to raise the question of the desirability of Parliament's deputing its law-making powers to other persons or bodies. I do not raise the question. I merely point out that when a statute authorizes officials or others to make rules and regulations or by-laws, it is not possible for a lawyer to explain the precise effect of the statute. Everything must depend on the future activity or inactivity of the officials concerned and on their wisdom.

I. LEGISLATION.

THE PUBLIC HEALTH ACT, 1936, which comes into operation on October 1st, 1937, contains provisions of interest to farmers who permit camping on their land.

Section 268 (1) provides that certain parts of the Act shall apply to tents, vans, sheds and similar structures used for human habitation in the same way as they apply to other houses and buildings. These parts contain regulations as to nuisances, disease, child welfare and so on, but it is not possible to enter here into the complicated details. The requirements are not likely to affect the genuine and well-conducted camper. If, however, difficulties are encountered, reference should be made to the Act.

Section 268 (2) provides that a tent or similar structure used for human habitation shall be a "statutory nuisance" if (*a*) it is in such a state, or so overcrowded, as to be prejudicial to the health of the inmates, or (*b*) if its use, by reason of the absence of proper sanitary accommodation or otherwise, gives rise, whether on the site or on other land, to a nuisance or to conditions prejudicial to health.

Where such a state of affairs exists, the local authority may serve upon the occupier of the dwelling, or in his absence upon the occupier of the land, an "abatement notice" requiring the

abatement of the nuisance. Where the nuisance arises from any defect of a structural character, the notice is to be served on the person who owns the premises. Where the person causing the nuisance cannot be found, and it is clear that no blame attaches to the owner or occupier of the premises, the local authority may themselves abate the nuisance.

If an abatement order is not complied with, the Court may make a "nuisance order" which may (*a*) require the abatement of the nuisance, (*b*) prohibit a recurrence, and (*c*) impose a fine of not more than £5. In addition the Court may prohibit the further use of the dwelling for human habitation. In the event of a nuisance order being ignored the Court may impose a further fine not exceeding £5 *plus* forty shillings for each day on which the offence continues, and the local authority may carry out the necessary work at the expense of the person against whom the order was made.

Section 268 (3) provides that, if the tents or similar structures constitute a nuisance, action may be taken against the occupier of the land as well as against the occupant of the tent.

By Section 269, a local authority may grant licences, authorizing (*a*) land to be used as the site of moveable dwellings and (*b*) the erection and use of such dwellings. Certain conditions may be attached to such licences.

In the absence of a licence, a person shall not allow any land occupied by him to be used for camping purposes on more than 42 consecutive days, or on more than 60 days in all in any year. For this purpose, different pieces of land in the occupation of the same person and within 100 yards of each other are regarded as the same piece of land.

A licence is, however (whatever the length of stay) unnecessary in the case of :—

- (i) A movable dwelling which is kept by its owner on land occupied by him in connection with his dwelling house and is used for habitation only by him or members of his household.
- (ii) A movable dwelling which is kept by its owner on agricultural land occupied by him and is used for habitation only at certain seasons and only by persons employed in farming operations on that land.
- (iii) Circuses, fairs and so on.
- (iv) A movable dwelling which is being stored on land on which no other moveable dwelling is inhabited.

Hop-pickers.—By Section 270, a local authority may make by-laws for securing the decent lodging and accommodation of persons engaged in hop picking and similar occupations.

Section 1 of the DISEASES OF ANIMALS ACT, 1910, as amended by the Exportation of Horses Act, 1914, renders it unlawful to export any horse, unless immediately before shipment it has been examined by a veterinary inspector and certified by him to be (*a*) capable of being conveyed to its destination and disembarked there without cruelty, and (*b*) capable of being worked without suffering.

By the EXPORTATION OF HORSES ACT, 1937, further restrictions are imposed, for, if the horse is

(*a*) a heavy draught horse, or
(*b*) a vanner, mule, or jennet, or
(*c*) an ass,

the inspector must certify, in addition to the matters mentioned above, that it is, in his opinion, not more than eight years old and worth not less than the following sums, viz.: in case (*a*), £25; in case (*b*), £20; and in case (*c*), £3. (These values may be altered by order of the Minister of Agriculture and Fisheries.) If the necessary certificate is not given, the horse cannot be exported. The certificate as to age and value is unnecessary, however, if the veterinary inspector is satisfied either

(*a*) that it is intended to use the horse as a performing animal, or
(*b*) that the horse is registered in the stud-book of a society recognized by the Minister of Agriculture and Fisheries, and is intended to be used for breeding or exhibition purposes, or
(*c*) that it is a foal at foot accompanying a horse which comes within case (*b*).

The Act also provides that if any horse examined is in such a condition that it is cruel to keep it alive, or if it is permanently incapable of being worked without suffering, it is to be slaughtered forthwith. In such a case, no compensation is payable to the owner.

It is important to notice that the expression "horse" includes ass and mule.

THE DISEASES OF FISH ACT, 1937, is intended to prevent the spreading of furunculosis among salmon and freshwater fish in Great Britain.

The following are its main provisions :—

1. The importation of live fish of the salmon family into Great Britain is forbidden.
2. Live freshwater fish or their eggs, or eggs of fish of the salmon family, may be imported into Great Britain only by persons holding licences granted by the Minister of Agriculture and Fisheries.

3. If the Minister is satisfied that the waters in any area are infected, he may make an order prohibiting or regulating the transport of live fish or eggs, or of foodstuff for fish, from that area. He may also arrange for the removal of dead and dying fish from the infected waters and, if necessary, authorize the occupiers of infected waters to remove any fish from the waters by such methods (including methods which would otherwise be illegal) as the Minister considers expedient.
4. It is the duty of any person entitled to take fish from any waters to give immediate notice to the Minister or to the Fishery Board if he suspects that the waters are infected.
5. If an inspector has reason to believe that the waters of any fish-farm are infected, he is forthwith to serve a notice upon the occupier and to report the facts to the Minister. After the service of the notice, no live fish, or eggs, or foodstuff for fish are to be transported from the fish farm until after the expiration of 16 days without the permission of the Minister.
6. Any Fishery Board or the occupier of any waters may ask the Minister for an inspection to see whether any infection is present, and this will be done free of charge.
7. In order that the Act may be enforced, search warrants may be issued to inspectors by justices in cases where there is reasonable cause for suspicion that an offence has been committed.

The following definitions from the Act may be useful :—

"Fish of the salmon family" includes all fish of whatever genus or species belonging to the family Salmonidæ.

"Foodstuff for fish" means any substance used, or intended or likely to be used, as food for fish, including natural food.

"Freshwater fish" does not include fish of the salmon family, or any kinds of fish which migrate to and from tidal waters but, save as aforesaid, includes any fish living in fresh water.

"Infected" means in relation to fish infected with the disease known as furunculosis and "infected waters" means waters in which furunculosis exists among fish, or in which the causative organisms of that disease are present.

"Occupier" means in relation to any waters a person entitled, without the permission of any other person, to take fish from the waters. In cases where the right to take fish is only for a period not exceeding one year, the person from whom the right was acquired, and not the person having the right, shall be deemed to be the occupier. A person who has the management of waters on behalf of a club is regarded as the occupier of those waters.

The Act may be extended by Order in Council to diseases other than furunculosis.

The Agriculture Act, 1937, has for its object the general improvement of farming conditions by encouraging attempts to make the land more fertile, ensuring that the prices of oats and barley do not fall below a certain level, and combating disease in stock.

Part I of the Act provides for the making of a Land Fertility Scheme under which contributions will be made out of public moneys towards the cost of lime and basic slag purchased for the purpose of improving the fertility of the soil. These contributions will be made until July 31st, 1940 (unless the time is extended), and they will not be greater than one-half the cost of the lime, or one-quarter the cost of the basic slag.

The Scheme came into operation on September 6th, 1937. It is to be noticed that contributions will not be paid on lime or basic slag that has been (*a*) produced outside the United Kingdom, or (*b*) delivered to agricultural land in quantities smaller than two tons at a time, or (*c*) mixed artificially with any other material, or (*d*) purchased from a person other than an approved supplier. Basic slag must contain not less than 8 per cent. of phosphoric acid, and its fineness must be such that at least 80 per cent. will pass through the British Standard Test Sieve mesh No. 100.

The Scheme will be administered by a Committee of five to be appointed by the Minister of Agriculture and the Secretaries of State for Scotland and Northern Ireland. In addition to the above, it will contain other provisions which it is considered will be conducive to the improvement of the land, and a scale of prices will be laid down which must not be exceeded by the supplier.

Persons who produce lime and slag for use on their own land should apply to the Committee for particulars of the conditions to be observed in order that a contribution may be claimed.

Part II of the Act provides for subsidy payments out of public moneys in respect of land under oats or barley.

These payments will be made to the occupiers of land under oats or barley if, in the case of the year 1937 or any of the four following years, the United Kingdom price per hundredweight of homegrown oats harvested in that year falls below 8*s.* by 5*d.* or more. Payments will be made at the rate of an amount equal to six times the difference between the price realized and 8*s.*, or at the rate of £1 (whichever rate is the less), per acre of land under oats or barley. Nothing will be paid in cases where there is less than an acre under oats or barley on the farm.

The Minister may make regulations providing that in cases

where, on June 4th in any year, a crop of oats or barley is growing intermixed with any other crop, the land under the mixed crop may be treated as being under oats or barley, but its acreage may be treated as reduced for the purposes of this Part of the Act. Regulations have been issued providing that the proportion of the acreage to be counted shall be the same as the proportion of oats and barley in the seed mixture used.

If it appears to the Minister that the crop of oats or barley obtained from any land in any year is unduly small or has been prejudicially affected either by the unsuitability of the land for growing oats or barley or by negligent cultivation, he may by order direct (*a*) that for the purposes of this Part of the Act, such land shall be disregarded, or (*b*) that the acreage of the land shall be deemed to be reduced to the extent ordered.

Subsidy will be paid only where the crop is harvested as grain, or where, owing to the weather, it is not cut until after September 15th.

Two technical terms require explanation. They are (1) "qualifying acreage," which means the total number of acres in respect of which payments may become due under this Part of the Act; and (2) "standard acreage," which means an acreage arrived at by multiplying the qualifying acreage in 1937 by the fraction $\frac{11}{10}$. It is laid down that if, in 1938 or any of the three following years, the qualifying acreage exceeds the standard acreage, the subsidy payments will be reduced so that the rate actually paid will bear to the rate which would otherwise be paid the same proportion as the standard acreage bears to the qualifying acreage. As an example, we may assume that the price per hundredweight of oats is 7*s.* Then the normal rate of subsidy payment would be 6*s.*, but if, in the particular year, the qualifying acreage is to the standard acreage as 120 is to 100, the rate would be reduced to 6*s.* $\times \frac{100}{120}$, *i.e.* 5*s.*

In cases where there is, on June 4th in any year, land under oats or barley on a farm and during the first eight months of that year there has also been land on the same farm under wheat, the occupier cannot get both the subsidy payment under this Act and the Wheat Deficiency payment. He must choose which he will take.

When a farm, whose occupier might have a claim under this Act or under the Wheat Act, 1932, changes hands before June 4th in any year, and the outgoer is entitled to re-enter to harvest any wheat, oats or barley, the proper course is to apply to the Minister (under Section 11, Sub-section 2) for directions as to procedure.

This Part of the Act may be administered by the Wheat Commission if the Minister, with the approval of the Treasury, authorizes them to do so.

It is important to notice that applications for subsidy must be sent to the Ministry by September 30th, so that by the time this article is in print it will be too late to apply this year. It is hoped, however, that the information given may be of some service in 1938.

Part III of the Act is concerned with Land Drainage, and authorizes the Minister to make grants out of public money towards expenditure incurred by drainage authorities in the exercise of their functions in carrying out drainage schemes. These grants will be of such amounts and subject to such conditions as may be approved by the Treasury. No grant can be made towards expenditure incurred after July 31st, 1940, unless the period is extended for a further one or two years.

The following drainage authorities will not be eligible for grants: (*a*) Catchment Boards, (*b*) the Council of any County Borough which has not established an agricultural committee constituted in accordance with a scheme approved by the Minister.

The powers conferred by this Part of the Act are not to prevent the provision to local authorities of financial assistance towards the cost of drainage works under the Special Areas (Development and Improvement) Act, 1934.

Part IV is devoted to provisions as to diseases of animals, and it begins by attaching to the Ministry of Agriculture and Fisheries all veterinary officers engaged in the execution of the Diseases of Animals Acts and of any enactments relating to milk or dairies.

It also provides that :—

1. The Minister may pay to the owner of any herd of cattle in Great Britain sums to be expended in securing as far as practicable that the herd will be free from bovine tuberculosis. These payments will be in accordance with a scheme to be made by the Minister and approved by the Treasury, and will not be made after January 31st, 1941.
2. Not later than January 31st, 1941, the Minister may, after consultation with the Board administering a milk marketing scheme, make an order for securing that if the Board are satisfied in respect of any milk produced after January 31st, 1941, that it has been produced by a registered producer in such circumstances as may be specified in the order, the Board shall pay to the registered producer such sum (not exceeding one penny per gallon) as may be specified in the order in respect of the milk. The object of this provision is the eradication of bovine tuberculosis, and the order will be framed with that end in view.

3. The Minister may, with the approval of the Treasury, expend such sums as he thinks fit with the object of eradicating as far as practicable diseases of animals in Great Britain. In this case, no scheme will be prepared.
4. The powers of the Minister under the Diseases of Animals Act, 1894 to 1935, shall be extended so as to include power to cause to be slaughtered any animal which (*a*) is affected or suspected of being affected with certain diseases or (*b*) has been exposed to the infection of any such disease. The diseases to which this provision applies will be specified in orders to be made by the Minister.

   Compensation will be payable in respect of any animal slaughtered under this new power.
5. The Minister may
   (*a*) declare any area in which the substantial majority of cattle are free from any particular disease to be an eradication area for purposes connected with the control of that disease;
   (*b*) declare any area in which any particular disease of cattle is for practical purposes non-existent to be an attested area for purposes connected with the control of that disease; and
   (*c*) prohibit or regulate the movement of cattle into or out of an eradication or an attested area.
6. Arrangements may be made, on request, for the free examination of poultry to determine whether they are free from disease, or from what cause they have died.

This Part comes into operation on such date as is directed by the Minister.

Part V provides for the acquisition of information by the Minister and the imposition of penalties on persons refusing information lawfully demanded, or claiming or applying subsidy payments improperly. It also contains definitions of certain words, some of which may be of interest.

"Agricultural land" means any land used as arable, meadow or pasture ground, or for the purpose of poultry farming, market gardens, nursery grounds, orchards, or allotments, including allotment gardens within the meaning of the Allotments Act, 1922.

"Animals" means cattle, sheep and goats and all other ruminating animals and swine and horses, asses and mules, and includes also, in the case of any particular section of Part IV of the Act, any other four-footed animal to which the Minister may by order declare that section to be applicable.

"Lime" means such forms of calcium oxide, calcium hydroxide, or calcium carbonate as may be specified in the Land Fertility Scheme.

"Poultry" means birds of the following species, domestic fowls, turkeys, geese, ducks, guinea fowls and pigeons.

It is set out in the preamble to the LIVE STOCK INDUSTRY ACT, 1937, that it is an Act "to make provision for the development and better organization of the live stock industry and industries connected therewith; for paying a subsidy to producers of fat cattle; for regulating the importation of live stock and meat, the holding of live stock markets and the slaughtering of live stock; and for purposes connected with the matters aforesaid."

The Act is divided into seven Parts, which can conveniently be considered separately.

Part I provides for the establishment of a body to be known as "The Live Stock Commission," upon which will rest the responsibility of putting the Act into operation and supervising its working. The Commission will consist of a chairman and not more than eight members appointed by "the Ministers," that is to say, the Minister of Agriculture and the Secretaries of State concerned with agriculture in Scotland and Northern Ireland. In addition to the particular duties imposed upon the Commission, this Part of the Act states that they shall have the functions—

(*a*) of keeping generally under review the production, marketing and slaughter of live stock, the preparation for sale of products of the slaughtering of live stock, and the marketing, consumption, treatment and use of such products, and

(*b*) of advising and assisting the Ministers in matters relating to the live stock industry.

They may hold such inquiries as they may consider necessary or desirable for the discharge of any of their functions.

In order to advise and assist the Commission, there is to be set up a "Live Stock Advisory Committee" which will consist of representative members and four additional members, all to be appointed by the Ministers. There is no indication of the principles governing the appointment of additional members except that they are to be appointed as independent persons, but the representative members of the Committee are to be persons representing the interests of:—

(*a*) persons carrying on in the United Kingdom the business of keeping live stock;

(*b*) local authorities in Great Britain;

(*c*) persons carrying on in Great Britain the business of effecting sales of live stock by auction, and

(*d*) such other interests as appear to the Ministers to be immediately affected, or likely to be immediately affected, by the operation of the Act.

Before appointing a person as a representative member, the Ministers shall consult such bodies as appear to be representative of the interest concerned.

There are to be three sub-committees of the Live Stock Advisory Committee—one for England, one for Scotland and one for Wales—and the members of these sub-committees need not necessarily be members of the Live Stock Advisory Committee. Any matter falling to be dealt with by the main Committee which concerns only one of the three countries will be referred to the appropriate sub-committee.

The members of the Cattle Committee have been appointed by the appropriate Ministers to serve on the Live Stock Commission. They are :—

Lieutenant-Colonel Sir John Chancellor, G.C.M.G., G.C.V.O., D.S.O. (chairman).
Sir Francis Boys, K.B.E.
George Dallas, Esq., J.P.
Sir Robert Greig, M.C., LL.D., D.Sc.
Sir Harold Howitt, D.S.O., M.C., F.C.A.
Sir John Boyd Orr, D.S.O., M.C., M.A., M.D., D.Sc., F.R.S.
The Honourable Jasper Ridley, J.P., B.A.

The Secretary of the Commission is Mr. H. Crow, O.B.E., of 1, Sanctuary Buildings, Great Smith Street, London, S.W.1.

Part II. The Cattle Subsidy. Subject to the provisions of orders and regulations to be made under this Part of the Act, subsidy payments will be made to producers of fat cattle in respect of—

(*a*) steers, heifers or cow-heifers sold or slaughtered in the United Kingdom on or after the appointed day by or on behalf of such producers, or

(*b*) the carcases of steers, heifers or cow-heifers sold or slaughtered as aforesaid.

The following schemes and regulations have been made pursuant to the powers conferred by this Part of the Act.

The Cattle Subsidy Scheme, 1937 (Statutory Rules and Orders 659), provides machinery for the grading and certification of animals in respect of which subsidy may be payable. The Scheme is much too detailed for adequate consideration here, but it should be consulted by all producers of fat cattle. Generally speaking, however, the arrangements are similar to those made under the Cattle Industry (Emergency Provisions) Acts, 1934 to 1936.

The Cattle Subsidy Regulations, 1937 (Statutory Rules and Orders 660), provides that in order that an animal may be

certified it shall conform to one of two standards defined by the Regulations. These are the "ordinary" and the "quality" standards, and they are defined as follows :—

(i) The ordinary standard shall be as follows :—

(*a*) the animal shall be reasonably well finished, the fat covering shall be fair, there shall be a reasonable amount of cod (or udder) fat, the flesh shall be of average thickness, and the animal shall be likely, so far as conformation and finish are concerned, to furnish a carcase conforming at least to the definitions of quality for the "Good" grade as prescribed in Regulations in force for the time being under the Agricultural Produce (Grading and Marking) Acts, 1928 and 1931 ; and

(*b*) the animal, as estimated by the Certifying Authority, shall have a killing-out percentage of not less than 54 per cent., that is to say, the weight of the carcase, as dressed in accordance with Regulation 4, shall, in the estimation of the Certifying Authority, be in the proportion of not less than 60½ lb. to each hundredweight of the live weight of the animal, such live weight to be the actual weight as ascertained in accordance with Regulation 3.

(ii) The quality standard shall be as follows :—

(*a*) the animal shall be compact, heavily and uniformly fleshed throughout, and relatively short in the leg ; the hind quarters, buttocks, loins and ribs shall be well developed and rounded ; the animal shall be ripe with excellent finish ; the fat covering shall be uniform and the cod (or udder) fat shall be adequate and firm ; the animal shall be likely, so far as conformation and finish are concerned, to furnish a carcase conforming to the definitions of quality for the "Select" grade as prescribed in Regulations in force for the time being under the Agricultural Produce (Grading and Marking) Acts, 1928 and 1931 ; and

(*b*) the animal shall, as estimated by the Certifying Authority, have a killing-out percentage of not less than 57 per cent., that is to say, the weight of the carcase, as dressed in accordance with Regulation 4, shall, in the estimation of the Certifying Authority, be in the proportion of not less than 64 lb. to each hundredweight of the live weight of the animal, such live weight to be the actual weight as ascertained in accordance with Regulation 3.

Regulation 3 lays down the method of computation of live weight and carcase weight, and Regulation 4 prescribes the method to be adopted in dressing carcases.

Regulation 5 prescribes the minimum weight to be attained by eligible animals and Regulation 6 defines "cow-heifer" as "any bovine animal which has calved, but which has not grown more than six permanent incisor teeth and still has at least one temporary incisor tooth."

The Cattle Subsidy Payments Order, 1937 (Statutory Rules and Orders 658). Payments will be made at the following rates :—

Home-bred animals of quality standard :

7*s*. 6*d*. per hundredweight live weight or 1½*d*. per pound dead weight.

Home-bred animals of ordinary standard :

5*s*. per hundredweight live weight or 1*d*. per pound deadweight.

Imported animals of quality standard :

5*s*. per hundredweight live weight or 1*d*. per pound dead weight.

Imported animals of ordinary standard :

2*s*. 6*d*. per hundredweight live weight or ½*d*. per pound dead weight.

The Cattle Subsidy (Marking of Imported Cattle) Order, 1937 (Statutory Rules and Orders 661), provides for the marking of cattle imported into the United Kingdom after August 1st, 1937.

The functions of the Cattle Committee set up by the Cattle Industry (Emergency Provisions) Act, 1934, will be transferred to the Commission on the appointed day, but an animal which has been certified in accordance with the provisions of the Act of 1934 will be deemed to have been sold before the appointed day provided that it is actually sold within one month after that day.

In this Part of the Act, the expression "producers of fat cattle" means persons carrying on in the United Kingdom the business of keeping cattle for the purpose of selling them in an improved condition or of fattening them for slaughter.

Part III. Regulation of Importation of Live Stock and Meat. The Board of Trade is empowered to regulate by order the importation into the United Kingdom of any such live stock or meat (except bacon and ham) as may be described in the order if it appears to the Board "that the making of the order is desirable in order to secure the stability of the market for live stock and meat in the United Kingdom."

In considering whether an order should be made the Board shall have regard :—

(*a*) to the interests of all classes of persons concerned, whether producers or consumers, and

(*b*) to the commercial relations between the United Kingdom and other countries.

Any order shall cease to have effect at the end of thirty days from the date when it is made unless before that time it is approved by a resolution passed by each House of Parliament.

The powers given to the Board by this Part of the Act supersede the similar powers conferred on it by the Agricultural Marketing Act, 1933, so far as live stock and meat (except bacon and ham) are concerned. It will be remembered that the powers under the Act of 1933 are effective only if a Scheme is in operation. There is no such restriction on the powers now conferred.

For the proper exercise of its functions under this Part of the Act or in connection with any international arrangements for control, the Board may demand information from any person occupying premises used for keeping meat in connection with any trade or business or from any importer of live stock or meat.

Part IV. Live Stock Markets. After November 1st, 1937, it will be contrary to the law to hold a live stock market on any premises unless :—

(*a*) a live stock market was lawfully held upon the premises at some time during the year ending on November 30th, 1936, or

(*b*) the premises are approved by an order of the Commission.

This restriction, however, will not affect :—

(*a*) the use of a farm for the purpose of effecting at the farm
- (i) a sale by the occupier (or on his behalf) of live stock which, at the time of the sale, he is keeping on the farm, or
- (ii) a sale of live stock incidental to the sale of the farm or the termination of a tenancy, or
- (iii) a sale in respect of which a special licence has been obtained from the Commission ; or

(*b*) the use of premises for a sale of a class which has been exempted by an order made by the appropriate Minister.

There is machinery provided for the making of "live stock markets orders" in cases where the Commission is satisfied that the holding of live stock markets in any area should be controlled in order that marketing may be conducted with efficiency and economy. An order may be made by the Minister after full inquiry, and, if necessary, reference to Parliament. Any order made will be administered by the Commission and may make provision :—

(1) for specifying the only premises (called approved market premises) in the particular area which may be used as live stock markets ;

(2) for compensating persons who suffer loss by reason of the order ;

(3) for improving existing premises;
(4) for securing that all expenses incurred by the Commission pursuant to the order shall be defrayed by means of contributions to be made by the owners of approved market premises and persons carrying on business at those premises, or premises outside the area which derive benefit from the order; and
(5) for other incidental matters which are considered necessary for the proper operation of the order.

Before any order is made, all interested persons have the right to be heard.

The Commission may make by-laws regulating the marketing of live stock on approved premises.

This Part of the Act also provides:—
(*a*) for appeals in certain circumstances by persons from whom a contribution has been demanded pursuant to an order;
(*b*) for the limitation of the rents and premiums payable in respect of approved premises; and
(*c*) for the enforcement of the provisions of the Part by local authorities. It is worthy of note that any member or officer of the Commission may, on production of a written authority, enter and inspect at all reasonable times any premises in Great Britain which the Commission have reason for believing to be premises used for holding live stock markets.

Part V. Slaughtering of Live Stock. This Part of the Act provides for the establishment, by order, of not more than three experimental "central slaughter-houses." Each of these will have a monopoly within a defined area, and all live stock to be slaughtered in that area will have to be brought to the central slaughter-house where a fixed charge will be made. Compensation will be paid to persons who suffer loss by reason of such an order. It seems probable that the experimental central slaughter-houses will be carried on by local authorities.

If it is decided that the establishment of central slaughter-houses is likely to promote efficiency and economy in slaughtering live stock, a grant not exceeding £150,000 may be made by the Exchequer to the persons concerned in operating them and a further sum of £100,000 may be advanced by way of loan.

Part VI provides for the setting up of Service Schemes which will have as their objects the encouragement and betterment of live stock breeding and marketing. These Schemes have some similarity to the Marketing Schemes established under the Agricultural Marketing Acts, and it may be useful if the main differences between the two types of Scheme are indicated.

1. The possible purposes of a Service Scheme seem to comprise a considerable number of the purposes of a Marketing

Scheme but not all of them. The Service Scheme purposes are more or less limited to education, research, insurance, advertising, the collection of statistics and so on, all of which may be, and often are, incidental objects of a Marketing Scheme. An authorized body under a Service Scheme, however, would probably not have the powers possessed by a Marketing Board to prescribe the persons to whom the goods may be sold, the description of and terms upon which goods may be sold, etc.

2. It is doubtful whether a Service Scheme could empower the authorized body to make laws and regulations as is done by a Marketing Board. The regulations which are to operate under a Service Scheme would have to be set out in the Scheme itself.

3. Offences against a Service Scheme are to be punished by means of action in the Courts, and not by fines imposed by the authorized body.

4. A Marketing Scheme requires the Board to keep a register of producers. A Service Scheme only requires a register insofar as it may be necessary for the effectual assessment and collection of contributions.

5. A Service Scheme will be brought into operation by the Minister on its submission to him by the Commission, which in its turn must be requested to submit a Scheme by a body substantially representative of the interests concerned. There is no poll of persons to be affected as there is in the case of Marketing Schemes.

6. A Marketing Scheme can be put an end to by a vote of producers. A Service Scheme can be terminated only by the Minister after consultation with the Commission. Before he revokes a Scheme, however, the Minister must be satisfied either (*a*) that there is a preponderating opinion in favour of revocation among the persons liable to make contributions under the Scheme, or (*b*) that the Scheme is not serving the purposes for which it was made, or (*c*) that the continued operation of the Scheme would be contrary to the public interest.

7. The body operating a Service Scheme may exercise its powers only in accordance with a programme to be submitted to the Commission each year and approved by them. This programme must give particulars of what the body propose to do in the year, and an estimate of the expenditure to be incurred.

Parts VII and VIII of the Act are devoted to Financial and General Provisions.

Throughout the Act, "live stock" means cattle, sheep and pigs, and "meat" means meat of live stock.

Amendments to the Milk Marketing Scheme.—On August 3rd, 1937, the Minister of Agriculture made an Order amending the Milk Marketing Scheme. Some of the alterations are of substantial interest to milk producers, whilst others deal only

with such matters as elections of Board members and other administrative details. I must assume that my readers are more or less familiar with the structure of the Scheme as it was before the amendments.

Tuberculin Tested Milk is the subject of the first group of important amendments.

The Minister has now permitted the Board to bring Tuberculin Tested Milk within the scope of the Scheme. In order to avoid administrative difficulties, however, the Board exempted sales of Tuberculin Tested Milk by registered producers provided delivery was made on or before September 30th, 1937.

The Scheme does not contain a definition of Tuberculin Tested Milk, but the Milk Special Designations Order, 1936, authorized the use of the designation "Tuberculin Tested" in relation to milk produced and handled under certain conditions set out in the Order and for the purposes of the Scheme it is probable that Tuberculin Tested Milk is milk which is produced and handled under those conditions, even where that designation is not in fact used in relation to it.

As the Scheme now stands, Tuberculin Tested Milk is subject to the control of the Board in like manner as is ordinary milk, with the following modifications :—

Paragraph 63 A provides that, in addition to any quality premium, the Board must pay out of the pool to the producer of Tuberculin Tested Milk a premium of not less than one penny per gallon in respect of the milk he sells, otherwise than by retail or semi-retail, during the period ending September 30th, 1939. In respect of Tuberculin Tested Milk so sold after that date the Board may determine the rate of premium, subject to the approval of a consulted person. Inasmuch as the producer of Tuberculin Tested Milk will also receive the quality premium payable under Paragraph 63 to producers of accredited milk, Tuberculin Tested milk producers will be receiving out of the pool twopence per gallon in excess of that which the producer of ordinary milk will receive. This is, of course, in addition to any premium which the buyer pays.

Paragraph 65, as amended, provides that if a producer sells Tuberculin Tested Milk by retail or semi-retail (and the expression "semi-retail" includes accommodation sales as defined by the Board) the levy which he will pay to the Board will be one penny less than if the milk were ordinary milk. This difference applies during the period ending September 30th, 1939. After that date the rate of levy may be varied by the Board, subject to the approval of a consulted person.

Paragraph 74, as amended, authorizes the Board to define what are retail sales and what are semi-retail sales of milk, but it is specifically provided that every sale by a registered producer of

Tuberculin Tested Milk, produced and bottled by him on the farm, is to be deemed to be a retail sale. The effect of this provision is that the producer does not sell such milk under a contract under which the purchase price is collected from the buyer and pooled by the Board. He sells it just as if he were selling to a retail customer, collects the price himself, and merely pays to the Board the reduced producer-retailer's levy mentioned above.

Similarly, it is specifically provided that Tuberculin Tested Milk delivered by its producer in quantities not exceeding, in the whole, ten gallons on any day to any one purchaser shall be deemed to be sold by semi-retail. The effect of this provision is similar to the provision referred to above in respect of Tuberculin Tested Milk which is bottled on the farm. The net result of these provisions is that the only Tuberculin Tested Milk which is sold under a registered contract will be milk not bottled at the farm, and which is sold in quantities exceeding ten gallons on any day to one buyer.

Important amendments affecting *Sales of Milk Generally* are as follows :—

The exemption, in Paragraphs 40 and 53, of the producer whose milk cows did not exceed four, is withdrawn.

Producers selling milk by retail have always done so without a registered contract and under licence issued by the Board. All other types of sale were supposed to be made under registered contract, the purchase money being collected by the Board and pooled. It was found not to be practicable for certain types of sale, such as semi-retail sales and accommodation sales, to be covered by registered contract on the lines indicated. Paragraphs 62 and 62A, as amended, provide that these sales may in future be treated as retail sales. The result is that the producer who effects such sales returns them in his monthly returns as if they were retail sales, and pays the retail levy on the sales.

Other amendments to Paragraph 62 extend the conditions which the Board may include in the producer-retailer licences. For example, the Board may now lay down conditions as to the descriptions of milk which may be sold, the manner in which it must be graded, and books and records to be kept by the licensee.

Paragraph 64, as amended, and the new Paragraph 64A, embody very substantial and involved alterations affecting depot milk. The Scheme as originally drawn did not envisage special terms to the buyer of milk delivered into collecting depots. Nevertheless it has for several years been the custom for the buyers of such milk to deduct from the price the sum of one farthing per gallon for "transit risk," together with an additional sum for "freight charge deduction," which was to cover the buyer's cost of carrying the milk from the collecting depot to

the consuming centre. Under the amended Scheme these charges will in future be paid to the buyer by the Board out of subsidiary pools for each region, called Regional Freight Pools. The regional freight pools will be fed by a charge called "the standard freight deduction," which will be a sum per gallon fixed by the Board in respect of each region. This charge will be debited by the Board to individual producers in respect of every gallon of milk delivered to a buyer who uses it for manufacture, and also in respect of every gallon of milk delivered into a collecting depot. Balances remaining in any regional freight pool at the end of a month may be carried forward or transferred to the regional pool. To sum up, the effect of these amendments is that all the producers in any given region who are delivering milk into depots or into factories will in future suffer an equal regional freight deduction instead of suffering varying deductions as in the past. I, of course, except the "delivery charges," *i.e.*, the charges for carrying the milk from the farm to the buyer's depot or factory, which will, as heretofore, be payable by the individual producer, and will vary according to the circumstances of the journey.

Paragraph 65 introduces substantial alterations as regards producer-retailers' levies. It was found that the levies payable by producer-retailers were somewhat heavy and the calculation was complicated. The new levies are fixed as follows :—

Ordinary milk, 1¾d. per gallon.
Accredited milk, 1d. per gallon.
Tuberculin Tested Milk, ¾d. per gallon.

If, however, a producer during the accounting period sells milk by wholesale (except on a contract carrying a level delivery premium) his contribution is increased by ½d. per gallon. If, nevertheless, he pays his levies punctually, *i.e.*, within 14 days after the due date, he receives a discount of ¼d. per gallon. The rates of levy mentioned above may be varied by the Board after July 31st, 1938, except as regards Tuberculin Tested Milk.

II. CASES IN THE COURTS.

Dolby v. *Halmshaw* (1937, 1 K.B. 196 ; 1936, W.N. 312).

Mr. Halmshaw was the owner of three greyhounds, which he was in the habit of coursing at informal, but not at formal, meetings. On November 9th, 1935, he was riding through a field with the permission of the owner. He had with him two of his greyhounds, and they chased and killed a hare. Mr. Halmshaw galloped across to where the greyhounds were, and having put the hare into a bag, left the bag in the bottom of a hedge. He was not in possession of a licence to kill game, and he was charged with killing game without a licence contrary to the Games Licences Act, 1860, Section 4 (1).

The justices acquitted on the ground that the Act does not apply to the pursuing and killing of hares by coursing with greyhounds (Section 5 (3)). Their decision was upheld by the High Court, it being stated that the exception applies not only to organized meetings, but to all coursing.

R. & W. Paul, Ltd., v. *The Wheat Commission* (1937, A.C. 139).

It was held by the House of Lords :—

1. That "German middlings" are not flour within the meaning of the Wheat Act, 1932.
2. That number 20 of the by-laws made by the Wheat Commission is *ultra vires* and invalid.

   This by-law seeks to exclude the operation of the Arbitration Act, 1889, from arbitrations under the Wheat Act.
3. That the Wheat Commission is a public authority within the meaning of the Public Authorities Protection Act, 1893, and so is protected against any action which is not commenced within six months from the date of the act complained of.

Rowell v. *Pratt* (53 T.L.R. 982).

In this case the National Farmers' Union in conjunction with certain of the Marketing Boards in England and Wales, by supporting an appeal to the House of Lords, has secured a very valuable protection of the rights of farmers. Under the various Agricultural Marketing Schemes, farmers have to send in returns to the Boards, and these returns, of course, contain much confidential information, which the farmer would not like made public property. In order to protect the farmer, Section 17 of the Agricultural Marketing Act, 1931, makes it a criminal offence for any person to disclose any information obtained by him in the exercise of any power conferred under the Act on any Board. This does not apply, of course, to disclosure for the purposes of legal proceedings *under the Act*, *i.e.*, proceedings by a Board against a producer.

In the case in question, however, the Court of Appeal held that the Section was not sufficiently clear to prevent such returns being compulsorily disclosed under an Order of the Court in ordinary legal proceedings between independent persons.

Mr. Rowell, the appellant in this case, grows potatoes at Inkerson Fen, near Sutton St. Edmunds. In 1934 he agreed to grow 9½ acres of Royal Kidney potatoes for the respondent, Mr. W. L. Pratt, trading as R. W. Green, of Wisbech, who was to supply the seed.

Mr. Rowell delivered some 74 tons of Royal Kidney potatoes to Mr. Pratt, who did not pay all the purchase price. Mr. Rowell, therefore, sued him for it, and Mr. Pratt admitted the claim.

He counterclaimed, however, a larger sum because he alleged that Mr. Rowell had not delivered to him all the potatoes produced from the 9½ acres, but had sold to certain other merchants some 43 tons of potatoes produced on those 9½ acres. The case was originally heard in the Wisbech County Court, and a number of witnesses were called on both sides. Mr. Pratt served a witness summons upon the Registrar of the Potato Marketing Board requiring him to produce Mr. Rowell's acreage return for 1934. The Registrar appeared with the return, but objected to producing the same on the ground that Section 17 of the Act of 1931 forbade this. The County Court Judge held that the return need not be produced. He believed the evidence called on behalf of Mr. Rowell to the effect that, in addition to the 9½ acres planted for Mr. Pratt, Mr. Rowell also grew 4 acres of Royal Kidney potatoes in another field, and that these were the potatoes which he sold to other merchants. Mr. Rowell, therefore, won his action, and Mr. Pratt's counterclaim was dismissed. Mr. Pratt took the matter to the Court of Appeal, who ordered a new trial on the ground that the County Court Judge was wrong in refusing to order production of the acreage return which might have been very important evidence and that, if it had shown only 9½ acres of Royal Kidney potatoes, then the decision might have been different. This was the view of two of the three Judges in the Court of Appeal, but the third Judge disagreed, and thought Section 17 of the Act of 1931 was sufficiently clear to prevent the return being produced in Court and used in evidence.

The matter was considered of great importance to farmers, and leave to appeal to the House of Lords was obtained, on the condition that an undertaking to pay the costs of the Appeal was given.

Five Judges in the House of Lords have now unanimously reversed the majority of the Court of Appeal and agreed with the decision of the County Court Judge.

Farmers can, therefore, rest assured that the returns which they make to the various Agricultural Marketing Boards are absolutely confidential documents, and cannot be used in evidence in legal proceedings, except proceedings under the Marketing Acts.

Collard v. *River Stour (Kent) Catchment Board* (1937, W.N. 30).

Mr. Collard was the owner of certain land at Stodmarsh, Kent, and a demand was made upon him for drainage rate in respect of this land by the Catchment Board pursuant to its powers under the Land Drainage Act, 1930. It was admitted (1) that for many years before 1930 a drainage rate had been charged upon and paid without question in respect of the land and (2) that the land was tidal land as defined by the Land Drainage Act, 1930, Section 77 (2). Mr. Collard contended that, since his land was tidal land, it was exempt from drainage rates. This

contention was founded on Section 77 of the Act which provides that " Subject as otherwise expressly provided in this Act, the provisions of this Act shall apply to land belonging to His Majesty. . . . Provided that nothing in this Act shall :—

(*a*) be taken to operate as a grant by or on behalf of His Majesty as owner . . . of any tidal lands . . . or

(*b*) be taken to authorize any person to do any work on, over, or under, or to use for any purpose, any tidal lands or any lands belonging to His Majesty . . . (with certain exceptions) ; or

(*c*) confer any power of levying drainage rates in respect of the said tidal lands.

It was upon proviso (*c*) that Mr. Collard relied. The Court held, however, that the three paragraphs to the proviso were consecutive and appeared to bear the same meaning throughout, and that it was to Crown property alone that the section referred. Accordingly, tidal lands which are not Crown property are not exempt from drainage rates.

Milk Marketing Board v. *Warman* (A.E.R. Vol. 3, 541).

This was an action by which the Board sought to recover from the defendant £182 10*s.* 6*d.* levies due under Paragraph 65 (1) of the Milk Marketing Scheme. The defence was that in 1933, before the poll was taken as to whether the Scheme should come into force, a pamphlet was issued to producers which contained the following passage : " In various parts of the country at the present time, the producer-retailer is feeling the pinch of severe undercutting, and the stabilization of the industry which will result from the operation of the Scheme will end all his anxiety under this head since undercutting will be impossible." The defendant alleged that this was a representation of fact, and that although the author of the pamphlet may well have thought it was true, it was in fact untrue. By the representation the defendant was induced to give his vote in favour of the Scheme. It was further argued on his behalf that the statement made in the pamphlet was a warranty or agreement, and that the Board had broken it by failing to stop undercutting. The defendant counterclaimed damages for this alleged breach of duty.

The defence was not accepted by Mr. Justice Charles, who held :—

(1) That if the passage referred to was a representation at all, it was future and not present and so could not be relied on in law.

(2) That the Board is under no legal obligation to stop undercutting. This, of course, does not mean that the Board have no power to stop undercutting. The result of the

decision is that if the Board do not choose to exercise the power they cannot be compelled to do so.

(3) That on the facts, the Board had taken all reasonable steps to stop undercutting.

Judgment was therefore given for the Board on the claim and counterclaim.

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AGRICULTURAL STATISTICS, 1937.

THE following table gives a summary of the acreages of crops and grass, and of the numbers of live stock, returned by occupiers of agricultural holdings on June 4th, 1937, together with the corresponding figures for 1936. The figures for 1937 are subject to revision.

TABLE I.

Acreage under Crops and Grass and Numbers of Live Stock *on holdings above one acre in extent in England and Wales as returned by occupiers on June 4th,* 1937, *and June* 4th, 1936.

Distribution.	1937. Acres.	1936. Acres.	Increase (+) or decrease (−) Acres.
Total Acreage under all Crops and Grass	24,772,000	24,863,000	− 91,000
Rough Grazings[1]	5,435,000	5,433,000	+ 2,000
Arable Land	9,018,000	9,120,000	− 102,000
Permanent Grass for Hay	4,671,000	4,669,000	+ 2,000
„ „ not for Hay	11,082,000	11,074,000	+ 8,000
Wheat	1,731,000	1,704,000	+ 27,000
Barley	823,000	819,000	+ 4,000
Oats	1,222,000	1,420,000	− 198,000
Mixed Corn	92,600	97,600	− 5,000
Rye	16,100	19,200	− 3,100
Beans, for stock feeding or seed	96,900	122,700	− 25,800
Beans, for market or canning	13,300	15,200	− 1,90
Peas, for stock feeding or seed	34,900	47,000	− 12,100
Peas, for canning or packeting, green or dried	25,200	28,100	− 2,900
Green Peas, for market	45,600	67,700	− 22,100
Potatoes, first earlies	55,200	56,300	− 1,100
Potatoes, main crop, including second earlies	399,900	400,300	− 400
Turnips, for stock feeding or seed	181,800	177,500	+ 4,300
Swedes, for stock feeding or seed	242,800	254,800	− 12,000
Turnips and Swedes, for human consumption	15,500	17,000	− 1,500
Mangolds	206,800	246,000	− 39,200
Sugar Beet	306,600	348,700	− 42,100
Kohl Rabi	6,100	5,400	+ 700
Rape (or Cole)	55,700	52,000	+ 3,700
Cabbage, Savoys and Kale for fodder	84,400	118,200	− 33,800
Cabbage, Savoys, Green Kale and Sprouting Broccoli, for human consumption	38,000	43,700	− 5,700

[1] Mountain, Heath, Moor, Down and other rough land used for grazing.

Distribution.	1937. Acres.	1936. Acres.	Increase (+) or decrease (−) Acres.
Brussels Sprouts	32,500	35,000	− 2,500
Cauliflower or Broccoli (non-sprouting)	18,800	20,500	− 1,700
Vetches or Tares	38,400	62,600	− 24,200
Lucerne	34,900	38,100	− 3,200
Carrots	13,900	16,600	− 2,700
Onions	1,700	1,600	+ 100
Mustard for seed	24,100	31,900	− 7,800
Hops	18,100	18,300	− 200
Small Fruit	52,800	55,700	− 2,900
Orchards	258,400	261,300	− 2,900
Clover and Rotation Grasses for Hay	1,469,000	1,340,000	+ 129,000
" " " " not for Hay	751,000	761,000	− 10.000
Bare Fallow	533,600	335,000	+ 198,600
	No.	No.	No.
Cows and Heifers in milk	2,215,500	2,227,500	− 12,000
Cows in Calf, but not in milk	394,500	405,100	− 11,100
Heifers in Calf	455,600	443,500	+ 12,100
Other Cattle—Under one year	1,264,400	1,215,800	+ 48,600
One year and under two	1,273,400	1,251,400	+ 22,000
Two years and above	1,011,100	997,000	+ 14,100
Total of Cattle	6,614,000	6,540,300	+ 73,700
Ewes kept for Breeding	7,316,000	7,237,900	+ 78,100
Other Sheep—One year and above	1,484,800	1,668,600	− 183,800
Over six months and under one year	322,000	437,500	− 115,500
Under six months	8,060,000	7,304,000	+ 756,000
Total of Sheep	17,182,800	16,648,000	+ 534,800
Sows kept for Breeding	455,000	483,200	− 28,200
Other Pigs—Over two months	2,138,900	2,220,600	− 81,700
Under two months	1,038,400	1,100,000	− 61,600
Total of Pigs	3,632,300	3,803,800	− 171,500
Horses used for Agricultural purposes (including Mares for Breeding)	554,500	561,400	− 6,900
Unbroken Horses (including Stallions)—			
One year and above	100,900	95,900	+ 5,000
Under one year	53,700	50,600	+ 3,100
Other Horses	149,000	157,700	− 8,700
Total of Horses	858,100	865,600	− 7,500
Fowls { Over 6 months old	24,517,000	25,362,000	− 845,000
Fowls { Under 6 months old	28,038,000	32,382,000	−4,344,000
Total of Fowls	52,555,000	57,744,000	−5,189,000
Ducks	2,281,000	2,606,000	− 325,000
Geese	552,000	634,000	− 82,000
Turkeys	687,000	707,000	− 20,000

The fall in the total agricultural area, as in the previous year, exceeded 90,000 acres, or about 0·4 per cent. of the total. This decline was entirely at the expense of cultivated crops and good grassland, the area of rough grazing showing a small increase. The loss of arable land exceeded 100,000 acres, 10,000 of which were laid away to permanent grass and the remainder given over to building or other non-agricultural uses.

The very large increase in the area of bare fallow was probably

due to seasonal conditions, being a legacy of the almost unprecedentedly wet spring.

Wheat and barley showed small increases (1·6 per cent. and 0·5 per cent. respectively). The areas of turnips and rape also increased, these crops probably replacing swedes and mangolds on land where a tilth could not be prepared in time for the latter crops. There was also a marked increase, of 119,000 acres, in the area of rotation grass. The potato acreage was practically maintained, but all the remaining major arable crops showed substantial decreases. The oat acreage fell by nearly 14 per cent., beans by 21 per cent., swedes by 5 per cent., mangolds by 16 per cent., sugar beet by 12 per cent., and cabbage and kale for fodder by 28 per cent. The figures, taken together, thus imply a serious decline in the output of our arable land, which decline was probably accentuated by lower average yields.

The areas of vegetable crops also showed substantial losses, but it must be borne in mind that the cultivation of these crops had largely expanded in the previous year. Over a period of years, as the following figures show, the acreages of the more important vegetables have been well maintained.

	Acres. 1933.	1935.	1937.
Cabbage, etc., for human consumption	33,100	37,500	38,000
Brussels Sprouts	35,900	34,100	32,500
Cauliflower and Broccoli	20,700	19,500	18,800
Carrots	12,900	15,800	13,900

Turning to the live stock figures, the total cattle population rose by nearly 74,000 head, an increase of more than 1 per cent. The increase was mainly in young stock, indicating some revival of confidence on the part of breeders. The largest proportionate increase was in cattle under one year, the figure being 48,600, or 4 per cent. The total of cows and heifers in milk or in calf showed an increase of 13,000 head.

Ewes increased by 78,000 or more than 1 per cent., and lambs numbered nearly half a million more than in the previous year. On the other hand there was a fall of 183,000 in the number of yearling sheep, following one of 77,000 in the previous year. These figures reflect the still growing tendency to market fat sheep at younger ages.

The pig population fell by 4·5 per cent., but it is well known that relatively large fluctuations in pig numbers are common.

The fall in the number of fowls, amounting to over 5,000,000 head, or about 9 per cent., is a reflection of the well known difficulties under which the poultry industry has been labouring. The rising level of feeding-stuff prices, together with the increasing incidence of disease, is sufficient explanation.

Table II sets out the number of workers employed in agriculture, and shows a further decline in the supply of labour.

The decline is, indeed, less than that which has occurred in several recent years, but there is no doubt that, owing to seasonal conditions, labour shortage was more acutely felt in 1937 than ever before. The inadequacy of the labour force and the wet spring combined to make the proper cleaning and cultivation of much land an impossibility. The number of workers who have left the industry in the past four years is 84,400, or about one in nine of the workers who found employment in 1933.

TABLE II.

Agricultural Workers.

	1937.	1936.	Increase (+) or decrease (−)
	No.	No.	No.
Regular Male Workers—			
21 years old and over	394,800	401,500	− 6,700
Under 21 years old	94,500	100,700	− 6,200
TOTAL	489,300	502,200	− 12,900
Casual Male Workers—			
21 years old and over	57,900	57,900	—
Under 21 years old	7,300	8,000	− 700
TOTAL	65,200	65,900	− 700
TOTAL MALE WORKERS, REGULAR AND CASUAL	554,500	568,100	− 13,600
Women and Girls—			
Regular Workers	46,200	44,600	+ 1,600
Casual Workers	30,400	27,900	+ 2,500
TOTAL	76,600	72,500	+ 4,100
TOTAL WORKERS, ALL CLASSES	631,100	640,600	− 9,500

JOHN AUGUSTUS VOELCKER.

With the death of Dr. J. A. Voelcker there passes one of the last of the great figures of Victorian agricultural science, and almost the last link with the founders of modern agriculture. He was born on June 24th, 1854, at Cirencester, where his father, Dr. John Christopher Augustus Voelcker, was Professor of Agricultural Chemistry. It was a great period for agricultural science, and Augustus Voelcker, as he was always called for short, was a great man to have as a father, for he had studied under Wöhler, Liebig and Mülder, and had come over from Germany in 1847 to take his residence here and do his life's work among us: he had been appointed Chemist to the Bath and West Society in 1855 and to the Royal Agricultural Society in 1857; and had held both positions till his death in 1884.

John Augustus Voelcker therefore grew up in the atmosphere of scientific agriculture. From his childhood he had known all the leading agriculturists of those days; he was thoroughly familiar with their aims and methods and he early absorbed the tradition of careful analytical work characteristic of his father's activities.

He was educated at University College School, then at University College, London, where he obtained both the B.A. and the B.Sc. degrees. He then proceeded to his father's old University at Giessen in Germany, obtaining his Ph.D. degree. Later on the University of Cambridge gave him an Honorary M.A. degree. He decided to take up agricultural chemistry as his profession, and in 1884, when his father died, he succeeded to all the public offices his father had held, including that of Consulting Chemist to the Royal Agricultural Society and to the Bath and West Society.

With his unique background of experience he naturally took his father's place in the world of agricultural chemistry and continued as the leading adviser of farmers on matters relating to fertilizers and feeding stuffs. Father and son served British agriculture well for 90 years—the longest sequence in our time.

His contributions to practical agriculture include his Reports, and a valuable series of notes issued periodically dealing with problems of current importance, especially new products or adulterated products. In addition, there was a large amount of sound advice privately given to farmers and landowners which played an important part in the daily conduct of the farm work. He was a shrewd and competent analyst, painstaking and very reliable. He speedily detected injurious substances in feeding stuffs (his work on Castor will long be remembered), while his analytical figures were so trusted that a large part of the sulphate of ammonia handled in this country was at one time sold on his

Dr. JOHN AUGUSTUS VOELCKER,
Consulting Chemist to Society 1885–1937.

reports. His high repute as an analyst is shown by the fact that he was elected President of the Society of Public Analysts. But he retained also a wide interest in General Chemistry. He served as member of the Council both of the Chemical Society and of the Institute of Chemistry.

His publications are almost all in the *Journal* of the Royal Agricultural Society, many of them in the form of Annual Reports which, taken together, give a summary of certain of the farmers' problems of the time. Another series of Reports, also issued annually, describes the experiments made at the Woburn farm, the Directorship of which he had also taken over from his father. This farm had been started in 1876 to deal experimentally with problems arising out of the new Act of 1875 awarding compensation to tenant farmers for unexhausted improvements. The Act had laid it down that compensation was to be paid, but said nothing at all about how this was to be done. Lawes and Gilbert had drawn up a table for assessing the residual manurial values of feeding stuffs but it was based on purely *a priori* grounds, and the Society's Chemical Committee of that time wisely decided to make field experiments as the only sure means of arriving at equitable assessments. The Duke of Bedford generously gave the use of some of his land for the purpose, and so the Woburn Farm was started. It had the further object of repeating some of the Rothamsted experiments on wheat and barley. When Dr. Voelcker took over the directorship from his father he widened its scope and made it a testing place for new crops and new feeding stuffs, and for studying such practical farming problems as the Committee from time to time selected.

For many years it served a most useful purpose, and it was greatly improved in 1897, when the late Mr. E. H. Hills left the Society a bequest of £10,000 for the purpose of studying the influence of unusual elements on the growth of plants. Out of the first income a laboratory and pot culture house were built—the first pot culture house to be set up in this country—and then a resident assistant was put in charge. Dr. Voelcker was always fortunate in his choice of men. The first was Dr. H. H. Mann, who in 1900 left Woburn for a distinguished career in India but has now returned as Assistant Director under the new regime, working as loyally now as he did at the beginning: others were H. M. Freear, who remained till his death in 1914, then James Crabtree, afterwards Superintendent of Experimental Sugar Farms in Demarara, then A. Blenkinsop who, like one of the Farm Managers, W. H. Hogg, rendered much subsequent valuable service to British Agriculture in the counties. The reports on the effects of these unusual elements are all published in the Society's *Journal*, but nothing of special interest emerged. Then in October, 1921, the Society decided to give up the farm and

to hand over the income from the Hills bequest to the Cambridge School of Agriculture. This was a heavy blow for Dr. Voelcker, from which he never quite recovered. It was made all the more bitter by the fact that at some of the other Institutions—the Institut Pasteur in Paris, Rothamsted and elsewhere, it was found, by using somewhat different methods, that some of these unusual elements are essential to plant growth, though in small quantities only; if they are lacking, the plants suffer from physiological diseases. Thus lack of boron, which was first investigated at Rothamsted, leads to heart-rot in swedes and sugar beet, and to another kind of rot in apples; lack of manganese leads to leaf stripe in oats; lack of copper to a special disease in cereals, especially wheat, but also in barley and oats. Moreover, according to recent Dutch work, cattle feeding on copper-deficient plants suffer from certain diseases. The latest addition to the list is cobalt, deficiency of which is said to cause a pining disease of cattle and sheep in Australia and New Zealand. It was nothing short of a tragedy that this work, begun under the ægis of the Society with the help of the Hills bequest, should have been abandoned too soon, so that results which ought to have been associated with the names of Hills and Voelcker and the Society are now to the credit of others.

Dr. Voelcker, however, did not despair; he gallantly shouldered the responsibility for carrying on the farm at his own expense till October, 1926, when the Rothamsted Experimental Station took it over. He remained Honorary Local Director and spent many months in association with the writer in summarizing the results both of the field and feeding experiments made since the beginning. He prepared an extended account which has not yet been published, though it would be a convenience to experts if this could be done. The account was condensed by the writer for publication in the book "Fifty Years of Field Experiments at the Woburn Experimental Station" of which it forms the first part; the second part consists of an examination of the field data by modern statistical analysis, made first by Miss M. A. Webster (now Mrs. E. W. Russell) then by Mr. W. G. Cochran; while the third was a summary by the writer of the various results of scientific and practical importance.

This is not the place to speak of the results of the Woburn experiments. Thanks to Dr. Voelcker's persistent advocacy and his enthusiastic demonstrations they impressed themselves on the visitors' minds and passed insensibly into practice. Few farmers who automatically include dressings of lime in the rotation where they have been using sulphate of ammonia realize that this practice is the outcome of experiments on Stackyard field; and even lecturers in agricultural chemistry often fail to recognize how much of their teaching on farmyard manure, on

silage and on many other topics is due to the analytical work done in connection with the Woburn experiments.

One of Voelcker's greatest enterprises was a journey to India made during 1890. It was a time of considerable change there. The need for agricultural improvement was widely recognized, and an Imperial Department had been set up in 1881 for this purpose under the Secretaryship of Mr. (afterwards Sir) Edward Buck. It was soon recognized that no advance could be made without technical advice, and the first requirement was for "one first-class expert who should make a general enquiry into the character of the soils and agricultural conditions of the country." Some time elapsed before anything happened, but in 1889 Dr. Voelcker was invited out to India. He arrived towards the end of the year and left early in 1891. His impressions and recommendations are contained in his book on the "Improvement of Indian Agriculture." One of the immediate results was the appointment of his old assistant, Dr. J. W. Leather, as agricultural chemist, thus starting the scientific service which has since developed enormously. For the rest, the merits of the Indian volume were not fully recognized until later. It was not till 1928 that the Royal Commission on Agriculture in India, which sat under the Chairmanship of the present Viceroy, reported: "Although thirty years have elapsed since this was written, the ability which Dr. Voelcker displayed in his comprehensive survey of the agricultural conditions in India, in his analysis of the problems they present and in his recommendations for their solution, still renders it a book of the utmost value to all students of agriculture in India. We are glad to have this opportunity of acknowledging the great assistance we ourselves have derived from it." This recognition brought with it the conferment of the order C.I.E. of which Dr. Voelcker was rightly very proud.

He was keenly interested in all aspects of agriculture and his social gifts made him a welcome member of any agricultural gathering. He was naturally attracted to the Farmers' Club, which he joined in 1885 and of which he became Chairman in 1908, a post his father had filled in 1875; in his opening remarks at the January meeting of 1908 he commented on the fact that his precedessor, Mr. Harold Howard, was also the son of a former Chairman. The occasion was further interesting in that Mr. H. Trustram Eve then read a paper on "Motive Power on the Farm," which he discussed in the order: wind, water, steam, oil engines, gas, electricity, and motors. The two last, however, seemed at that date somewhat improbable: "where there is sufficient water power on the farm electrical power could be produced with economical results"—while as for tractors: "they are not commercially used on farms of ordinary sizes in England . . . a farmer is right in using his team of horses

instead of buying extra power for cultivating the land." So much have times changed in a single generation.

Dr. Voelcker was a man of very wide interests and of much social value. At College he had been a runner of no mean order for anything between one and ten miles, and his interest in athletics continued to the end. He was the first honorary secretary of University College and Hospital Sports; for long he was treasurer of the Thames Hare and Hounds, and was frequently present at Roehampton when they had a race; he was also twice President of the London Athletic Club and regular in his attendance at their Committee meetings. But he was never content with mere passive onlooking. He was a keen fisherman, having had a fishing on the Test and for a number of years spent part of his holidays in Northumberland; he was also a keen shot and a golfer; altogether a good type of English country gentleman.

Nor did his interests stop here. He was an active member of the Presbyterian Church and not infrequently, after a day's work, would preside or take a considerable part in some evening meeting at one of the churches belonging to that body. The simple and very beautiful memorial service at St. John's Presbyterian Church, Kensington, had been arranged in accordance with his wishes and it well showed his sense of spiritual values.

In 1884, at the age of 30, he married Alice, eldest daughter of the late Mr. W. Westgarth, formerly of Melbourne, and they had two sons and two daughters. The elder son was killed in the War and the younger broke away from agricultural chemistry, but his brother's son, Mr. Eric Voelcker, is carrying on the consulting practice, so that the name seems likely to survive in agricultural activities.

His tall, striking figure, set off by a fine head adorned with white hair, made him noteworthy in any company. His essential tidiness of mind showed itself in his systematic note-taking, in his immaculate dress, and his punctiliousness in all his commitments and engagements. As he walked round my room he would put the pictures straight and would gently rebuke any disorderly appearance of the desk or bookshelves. While he distrusted some of the newer methods of field experiment he accepted them and faithfully carried them out: for once he had given his word he would hold to it. As a chief he captured and held the deep respect, even the admiration, of his staff, while as a friend he was loyal and entirely trustworthy: a man one is glad to have known, and who played his part gallantly in serving his generation.

E. J. RUSSELL.

Rothamsted Experimental Station.

THE WOLVERHAMPTON SHOW, 1937.

ALTHOUGH the neighbouring City of Birmingham has had two Royal Shows, Staffordshire is a county that has been visited by the Society on only one former occasion. Wolverhampton was then the venue, and the meeting was held as far back as 1871. Judging from contemporary reports, the Show of that year took place under anything but happy conditions.

The Show of 66 years ago was remarkable, we are told in the Steward's report, for a "marvellous array" of steam cultivating machinery and traction engines which were subjected to exhaustive trials, the practical results of which were of the highest value.

In spite of the unfavourable weather during the Society's previous visit, there was a comparatively large "gate," as will be seen from the particulars given below of Birmingham and Wolverhampton meetings :—

Year.	Place.	President.	No. of Implement Stands.	Entries of Live Stock.	No. of Persons Admitted.	+ = Profit − = Loss
1871	Wolverhampton	6th Lord Vernon	363	1,267	107,519	− £2,175
1876	Birmingham	2nd Lord Chesham	420	1,499	163,413	+ 3,424
1898	Birmingham	5th Lord Spencer	502	2,323	98,277	− 1,568
1937	Wolverhampton	Mr. U. Roland Burke	409	3,191	78,080	+ 680

Fortunately, the 1937 Show took place under far pleasanter conditions and in a much clearer atmosphere than its predecessor of 1871. The helpful co-operation of the Mayor of Wolverhampton (Sir Charles Mander), the Corporation and the Local Committee on this occasion left nothing to be desired, and, if no spectacular records were set up in the way of attendance and financial result, it cannot be said that this was due to any lack of enthusiasm on the part of Wolverhampton.

The site generously placed at the disposal of the Society by Lord Wrottesley has been described by the President (Mr. Burke) as one of the nicest the Society has ever had for its Show. It may not be without interest here to note that the Wrottesley estate has been in the possession of his Lordship's family since the 12th century, and that in 1347 one of his ancestors received a charter from Edward III to make a park there.

The showground covered over 100 acres of the Park, and was about four miles from the railway stations and the centre of the town. Most efficient means of transport were, however, provided by the Corporation and bus companies for visitors. The principal entrance and administrative offices were on the main road to Shrewsbury, and there was a second entrance for the public near the south corner of the ground not far from the

Flower Show. Two car parks of ample dimensions were arranged near the entrances, and on some days of the Show the available accommodation was taxed to its utmost. An idea of the volume of the car traffic may be gathered from the particulars given below of the vehicles dealt with in the parks by the staff of the Royal Automobile Club :—

	Cars.	Motor Cycles and Combinations.	Car " Seasons."
Tuesday	2,325	14	550
Wednesday	5,140	53	163
Thursday	4,964	176	8
Friday	2,074	41	—
Saturday	1,176	265	—

The rather unusual shape of the site necessitated a somewhat different lay-out from that which is usually associated with the " Royal," but the exhibition was found by visitors to be very compact, and one in which it was easy to find one's way about.

Electricity was again the lighting, cooking, and motive power at the Show, and this was supplied by the Wolverhampton Corporation on most favourable terms to the Society and exhibitors.

As soon as the Council accepted the invitation to visit Wolverhampton, the Staffordshire Agricultural Society agreed to forego their own county show for the year, and, as usual, privileges were extended to their members similar to those enjoyed by members of the parent Society.

Of the customary comprehensive character, the list of prizes, including cups, medals, etc., amounted to £15,949, towards which £3,640 was contributed by various Breed Societies. Details of the Classification, Prizes, and Entries are tabulated in a statement which follows, and another table is included giving a comparison of this year's entries in the different sections with those of previous years. A complete List of the Awards will be found in the Appendix to this volume.

Implements and Machinery formed one of the best sections of its kind ever brought together by the Society.

Live stock, too, made a fine exhibition. Horses made a creditable show, particularly the heavy breeds, which were led by the Suffolks with an entry of 109. The great feature of the Cattle section was a magnificent entry of 194 Dairy Shorthorns. A representative display was made in the Sheep classes, Southdowns with an entry of 94, as usual, heading all other breeds. Exhibits of Pigs made a collection of much interest, nearly a third of the entry being of the Large White breed.

For the first time, arrangements were made at Wolverhampton for daily parades of the prize-winning pigs of all breeds in rings

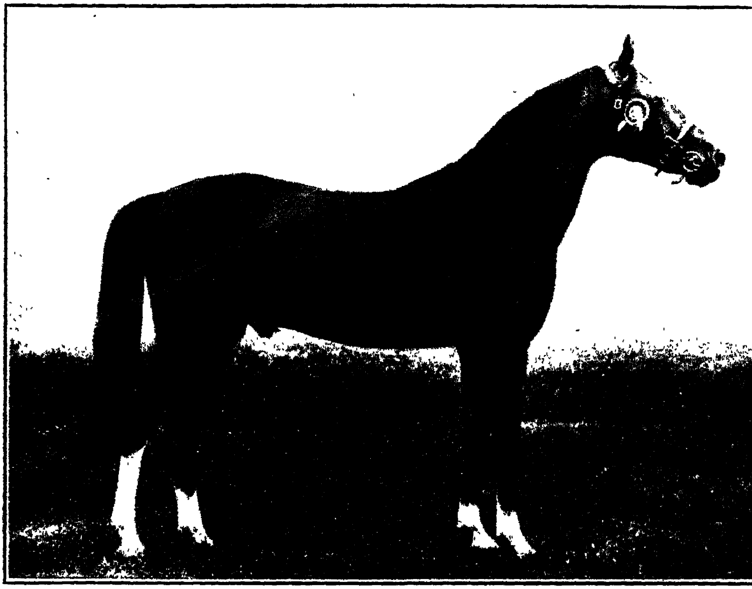

FIG. 1.—ARAB STALLION, "SAOUD."
Winner of Champion Medal for best Arab Stallion or Colt, Wolverhampton, 1937.
Exhibited by MR. H. V. MUSGRAVE CLARK.

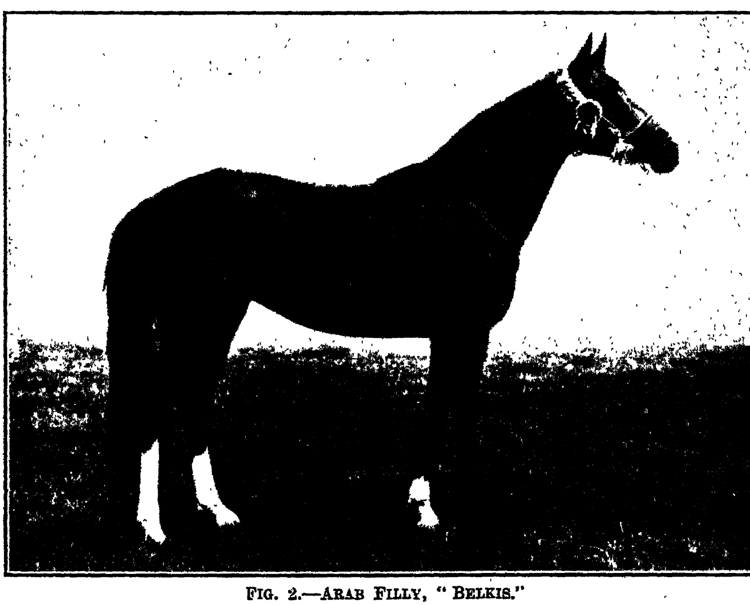

FIG. 2.—ARAB FILLY, "BELKIS."
Winner of Champion Medal for best Arab Filly, Wolverhampton, 1937.
Exhibited by MR. H. V. MUSGRAVE CLARK.

FIG. 3.—GUERNSEY BULL, "VALENTINE'S SOUVENIR DE VIMIERA."
Winner of Challenge Cup for best Guernsey Bull, Wolverhampton, 1937.
Exhibited by MR. R. H. BRITTAIN.

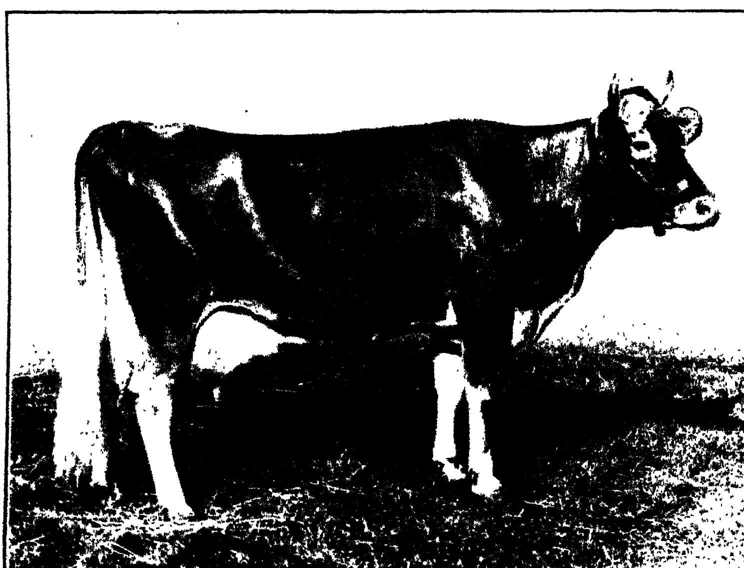

FIG. 4.—GUERNSEY COW, "FERNHILL ROSE 8TH."
Winner of Challenge Cup for best Guernsey Cow or Heifer, Wolverhampton, 1937.
Exhibited by MR. W. DUNKELS.

STATEMENT OF ENTRIES, ETC.,
At Show held at Wolverhampton in 1937.

HORSES, CATTLE, AND GOATS.	1937. Classes.	1937. Entries.
HORSES :—		
Prizes		*£3,913*
Shire	11	69
Clydesdale	8	29
Suffolk	13	109
Percheron	9	51
Hunter	10	81
Polo Pony	5	29
Arab	3	22
Welsh Pony	2	9
Shetland Pony	2	17
Riding Classes—		
Hunters	7	110
Cobs	1	6
Hacks	2	22
Children's Ponies	3	35
Driving Classes	10	68
Mounted Police	2	43
Jumping	5	206
Total for HORSES	93	906
CATTLE :—		
Prizes		*£6,731*
Shorthorn	11	85
Hereford	9	75
Devon	5	24
Sussex	4	14
Welsh	4	20
Park	3	11
Longhorn	4	17
Aberdeen-Angus	6	83
Belted Galloway	4	14
Galloway	4	17
Highland	3	—[3]
Dairy Shorthorn	11	194
Lincolnshire Red Shorthorn	7	47
South Devon	4	15
Red Poll	9	111
Blue Albion	5	23
British Friesian	13	128
Ayrshire	8	94
Guernsey	8	89
Jersey	7	130
Kerry	3	13
Dexter	5	41
Milk Yield	11	100
Butter Test	2	64
Total for CATTLE	150	1,409[1]
GOATS :—		
Prizes		*£120*
Inspection Classes	10	57
Milk Yield	2	69
Total for GOATS	12	126[1]

SHEEP, PIGS, POULTRY AND PRODUCE.	1937. Classes.	1937. Entries.
SHEEP :—		
Prizes		*£2,108*
Oxford Down	5	40
Shropshire	6	42
Southdown	7	94
Hampshire Down	5	37
Suffolk	6	43
Dorset Down	3	22
Dorset Horn	4	12
Wiltshire Horn	3	10
Ryeland	4	21
Kerry Hill (Wales)	5	38
Clun Forest	5	33
Lincoln	4	19
Leicester	4	17
Border Leicester	4	28
Wensleydale	5	24
Kent or Romney Marsh	6	43
Devon Long Wool	2	6
Devon Close Wool	2	—[3]
South Devon	2	6
Dartmoor	2	6
Cheviot	2	—[3]
Welsh Mountain	2	15
Black Welsh Mountain	2	10
Total for SHEEP	90	566
PIGS :—		
Prizes		*£1,703*
Large White	8	218
Middle White	8	61
Tamworth	6	42
Berkshire	8	68
Wessex Saddleback	6	43
Large Black	8	66
Gloucestershire Old Spots	6	23
Cumberland	4	21
Essex	8	113
Long White Lop-Eared	5	21
Welsh	5	27
Total for PIGS	72	703
POULTRY :—		
Prizes		*£371*
Total Entries	110	627
PRODUCE :—		
Prizes		*£377*
Total Entries	53	339

Grand Totals for LIVE STOCK, POULTRY, PRODUCE, &c., in 1937 } 580 Classes . 4,676 Entries . *£15,949* Prizes.[2]

[1] Animals exhibited in more than one class are here counted as separate entries.
[2] Including £502 for Flower Show, £78 for Butter-Making Competitions, and £46 for Local Classes.
[3] Classes cancelled under regulation of Prize Sheet.

in close proximity to their pens, an innovation which excited a good deal of interest.

In recent years an increasing amount of attention has been paid to the comfort and well-being of the stockmen and grooms who come to the Show with the exhibits of live stock. At Wolverhampton an effort was made to improve, to some extent, the sleeping accommodation of attendants, the nature of whose duties preclude them from being away from their charges during the night. These men have expressed their appreciation of all that has been done for them and for their comfort.

The Midland Division of the Young Men's Christian Association did useful service in providing all-night coffee bars before and after the Show, evening concerts for the men, and supplying reading matter and materials for writing letters, and generally organizing welfare work among them. A programme of sports, much on the same lines as at former Shows, was also arranged and carried through by the Association in conjunction with the British Herdsmen's Club.

The President and Mrs. Burke attended the concert on the Friday evening, and Mrs. Burke handed the prizes to the winners in the various "sports" events.

Poultry entries were below average in number. In the Produce section, Cheese accounted for 118 entries out of a total of 339.

The Flower Show again furnished a most attractive section of the exhibition, a number of special classes being included at the request of the authorities of the Wolverhampton Floral Fete which, on account of the Society's visit, was not held this year.

Separate reports appear in later pages of this volume on the Forestry and Agricultural Education exhibits.

Fine weather, not too warm, allowed the judging of all the breeding classes of live stock to be carried through quite comfortably on Tuesday, July 6th. The cream from the milk of the cows in the Butter Test classes was churned in the Working Dairy during the day, thus enabling the awards in this section also to be made known in the early part of the Show. Full details are given in the Report of the Steward of Dairying.

An attendance of 4,341 was recorded during the opening day. Distinguished visitors included many from the Dominions and from the Continent.

The principal event on the Wednesday was the official visit of Their Royal Highnesses the Duke and Duchess of Gloucester. On their arrival, shortly before noon, they were received by Mr. Burke, as President, and Members of the Council and Local Committee. Their Royal Highnesses devoted the first part of their tour of the showyard to an inspection of exhibits in the Flower Show and the Forestry Exhibition. They honoured the

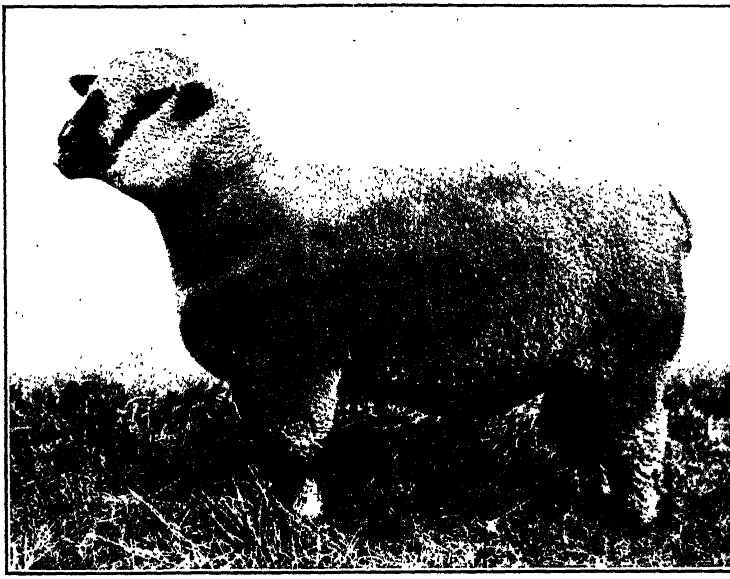

FIG. 5.—HAMPSHIRE DOWN SHEARLING RAM.
Winner of Champion Prize for best exhibit of Hampshire Down Sheep, Wolverhampton, 19
Exhibited by MAJOR V. S. BLAND.

FIG. 6.—WENSLEYDALE SHEARLING RAM.
Winner of Challenge Trophy for best exhibit of Wensleydale Sheep, Wolverhampton, 1937.
Exhibited by MR. JOHN DARGUE.

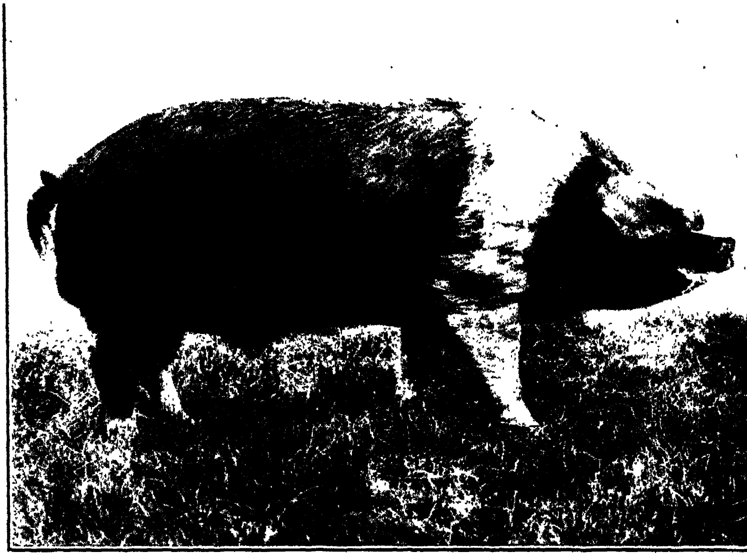

FIG. 7.—ESSEX BOAR, "HUSKARDS WEELEY NEVILL 2ND."
First Prize and one of Group winning Challenge Cup for best group of Essex Pigs. Wolverhampton, 1937.
Exhibited by MR. HAROLD H. BOWSER.

FIG. 8.—ESSEX SOW, "MAGDALEN PRIDE 75TH."
First Prize and one of Group winning Challenge Cup for best group of Essex Pigs, Wolverhampton, 1937.
Exhibited by MR. HAROLD H. BOWSER.

STATEMENT OF ENTRIES FOR THE 1937 SHOW, COMPARED WITH PREVIOUS YEARS.

Entries of Live Stock, Poultry & Produce.

	Wolverhampton, 1937.	Bristol, 1936.	Newcastle, 1935.	Ipswich, 1934.	Derby, 1933.	Southampton, 1932.	Warwick, 1931.	Manchester, 1930.	Harrogate, 1929.
Horses	*620	*617	*644	*729	*592	*437	*568	*512	*634
Cattle	*1,245	*1,252	*1,060	*1,281	*1,149	*1,009	*1,168	*1,164	*1,263
Goats	*57	*68	*68	*107	*97	*75	*68	*48	*92
Sheep	566	592	684	576	573	520	569	735	723
Pigs	703	669	593	841	688	551	688	678	691
Total	3,191	3,198	3,049	3,534	3,099	2,592	3,061	3,137	3,403
Poultry	627	651	668	792	984	840	741	901	943
Produce	339	426	332	269	264	274	258	506	363

* Exclusive of Double Entries.

Shedding in Implement Yard (in Feet).

Description of Shedding.	Wolverhampton, 1937.	Bristol, 1936.	Newcastle, 1935.	Ipswich, 1934.	Derby, 1933.	Southampton, 1932.	Warwick, 1931.	Manchester, 1930.	Harrogate, 1929.
	Feet.	Feet.	Feet.	Feet.	Feet.	Feet.	Feet.	Feet.	Feet.
Ordinary	1,950	1,765	1,760	2,240	2,095	1,845	2,190	2,690	2,995
Machinery	4,150	3,850	3,880	3,530	2,935	2,630	3,690	4,515	4,170
Special (Seeds, Fertilizers, etc.)	2,989	3,163	3,071	3,176	3,360	2,450	3,083	3,488	3,686
Total (Exclusive of Open Ground Space.)	9,089	8,778	8,711	8,946	8,390	6,925	8,963	10,693	10,851
No. of Stands	409	377	356	387	349	311	388	443	431

President with their presence at luncheon in the Royal Pavilion. In the afternoon the Royal visitors resumed their tour, in the course of which they inspected a number of stands, including those of the Lord Roberts' Memorial Workshops, the National Council of Social Service, the Rural Industries Bureau, the Wolverhampton Development Association, as well as the Agricultural Education and Research Exhibition. They then went on to the Royal Box in the grandstand, from which they witnessed a number of events in the large ring, returning later to the Pavilion for tea. Before leaving the Show, the Duke of Gloucester presented the Gold Challenge Cup and other awards in the Young Farmers' International Dairy Cattle Judging Competition.

The following letter was subsequently received by the President :—

"York House,
"St. James's Palace,
"*9th July*, 1937.

"SIR,

"The Duke of Gloucester wishes me to write and tell you how much the Duchess and he enjoyed their visit this week to the Royal Agricultural Show at Wolverhampton. Their Royal Highnesses were much interested in all they saw on the Show Ground during their tour, which was admirably arranged.

"I am desired to convey to you in particular as President and Honorary Director of the Show, to your Council, and all others concerned, Their Royal Highnesses' congratulations on what was obviously a very successful Show, together with their best thanks for the arrangements which were made for their visit.

"I am, Sir,
"Your obedient Servant,
(*Signed*) "RONALD STANYFORTH.

"U. ROLAND BURKE, Esq.,
"President,
"The Royal Agricultural Society of England."

Loud-speaking apparatus was installed for the first time at a Royal Show for announcing the Jumping Competitions and results, and was used successfully from Wednesday onwards until the close of the Show.

Thursday was marked by the attendance of the Lord Mayor of Birmingham, the Lord Mayor of Cardiff, and the mayors of a number of boroughs in the neighbourhood of the Show, who were the guests of the President.

In the Conference Tent during the morning took place the general meeting of the Society's Governors and Members, when cordial thanks were tendered by them to Sir Charles Mander (the Mayor), the Corporation, and the Local Committee for all they had done to promote the success of the Show.

In the early hours of Friday, July 9th, an area in the Midlands experienced a slight earthquake shock. Although this was noticed in Wolverhampton, the tremor does not appear to have been sufficient to upset any of the animals in the showyard.

Heavy rain during Friday unfortunately kept many thousands of people away from the Show, and thus shattered any hopes there might have been of a record "gate" at Wolverhampton.

Several additional ring attractions were arranged for Saturday, the closing day. These included a series of interesting jumping events by members of a number of Pony Clubs in the surrounding

district and competitions for Mounted Police. Despite the excellent programme provided the attendance of visitors was again disappointing.

Details of this year's turnstile returns, with comparative figures for previous years, are given below :—

Admissions by Payment at Wolverhampton.

Day of Show.	11 a.m.	1 p.m.	3 p.m.	5 p.m.	Day's Total.
Tuesday (5*s.*) .	1,611	3,066	3,829	4,243	4,341
Wednesday (5*s.*) . after 2 p.m. (3*s.*)	4,138	11,098*	16,689	21,053	21,536
Thursday (3*s.*) .	7,466	18,433	24,474	28,433	29,051
Friday (2*s.* 6*d.*) .	3,041	6,929	9,027	10,132	10,395
Saturday (1*s.*) .	1,720	4,700	8,441	12,350	12,757
Total for Show					78,080

* 2 p.m.

Total Daily Admissions at 1937 Show compared with those of the previous six Shows.

Day of Show.	Wolverhampton, 1937.	Bristol, 1936.	Newcastle, 1935.	Ipswich, 1934.	Derby, 1933.	Southampton, 1932.	Warwick, 1931.
First . . .	4,341	4,089	5,246	4,823	3,171	1,116	1,887
Second . .	21,536	14,873	25,985	23,137	21,684	8,165	11,273
Third . .	29,051	19,886	38,892	37,628	26,981	11,686	24,198
Fourth . .	10,395	17,825	19,466	21,165	13,573	11,997	15,193
Fifth . . .	12,757	16,133	43,931	20,248	30,941	14,614	19,708
	78,080	72,806	133,520	107,001	96,350	47,578	72,259

During the week musical programmes were given by the Band of the 5th Royal Inniskilling Dragoon Guards, and a detachment from that regiment gave musical rides and displays of trick riding.

The Albrighton, North Stafford, Albrighton Woodland and Wheatland Hounds took part in parades in the ring, and the teams of horses of the Shire and Suffolk breeds evoked much interest.

The pavilion of the Ministry of Agriculture was again a "side-show" of much interest. Live cattle, sheep and pigs were exhibited with the object of demonstrating the types of animals likely to be placed in the several carcase grades under the marketing scheme. The practical advantages to be derived from grading and packing, up to National Mark standards, were also demonstrated on a number of products.

Under the auspices of the National Milk Publicity Council an attractive bar for the sale of milk drinks was erected in a prominent position. The business done showed an increase on last year—between 800 and 900 gallons of milk were disposed of, the drinks served being some 17,000.

The number of visitors from overseas was probably larger than on any former occasion, due in some measure, no doubt, to the fact that many of those who came from the Dominions for the Coronation had extended their stay in England, and that there were already in this country a number of people who had come over as delegates to the Fourth International Grassland Congress, which took place in July at Aberystwyth.

T. B. Turner.

REPORT ON NEW IMPLEMENTS, WOLVERHAMPTON SHOW, 1937.

Three of the implements entered at Wolverhampton were awarded medals. The successful entries were :—

(1) Grass mower elevator .	. John Wilder, Ltd.
(2) Oil-fired sterilizing plant	. Halliday Boilers, Ltd.
(3) Drainage trench excavator	. R. H. Neal & Co., Ltd.

The unsuccessful entries were :—

(1) Grass drying equipment .	. Sir Bernard Greenwell, Bart.
(2) Bracken breaker . .	. Harrison McGregor & Co., Ltd.
(3) Cylinder head gasket .	. Headen Keil Engineering Co., Ltd.
(4) Crude oil carburettor .	. Headen Keil Engineering Co., Ltd.
(5) Tractor cultivator attachment	Miller Wheels, Ltd.
(6) Clod cutter	. J. C. & T. Yates.
(7) Cream separator . .	. Wolseley Sheep Shearing Machine Co., Ltd.
(8) Horse and cattle clipper	. Wolseley Sheep Shearing Machine Co., Ltd.

Two entries were deferred, viz :—

(1) Grass drier . . .	. Mobile Driers, Ltd.
(2) Thatching needle . .	. John H. Darby.

Successful Entries.

I. Grass Mower Elevator. John Wilder, Ltd., Reading. Price £150.

This machine is a development of the mower-elevator which was awarded a Silver Medal, as an experimental machine, at Derby in 1933. The original model consisted of an elevator attached to the cutter bar of a standard mowing machine and, although the actual work of collection was quite satisfactory, the outfit in practice was unwieldy and difficult to manœuvre.

The present machine has been completely rebuilt in the light of experience gained in the intervening period. The mower unit now has a power drive from its own engine, while mower and elevator are built into a rigid chassis. The chassis is carried on a front castor wheel and two main pneumatic-tyred land wheels, from one of which the elevator drive is taken. This arrangement has the advantage that there is no strain on the mechanism and cutter bar when turning, and no tendency to side draft even when a fully loaded trailer is hauled behind.

These modifications cause the machine to fall into a category referred to in my report for 1926, *i.e.*, a combination of new elements of design which constitute, in effect, almost a new machine.

It was not possible to arrange a formal test of this entry, but two separate outfits were inspected at work. One of these was dealing with long grass on an aerodrome, while the other was cutting and collecting short grass for delivery to a drier.

Both machines were doing excellent work, cutting and collecting quite cleanly without blockage of any kind. In order to test the advantages of the new arrangement the outfit was made to work under the following conditions—

(1) Cutting at high speeds up to 4½ miles per hour.
(2) Doing sharp turns while cutting.
(3) Working up, down and across a fairly steep slope.

The ease of attaching and detaching tractor and trailer, and the arrangement of the machine for transport, were also noted.

The machine came through these trials very satisfactorily. It can work on as short a turn, and can cut as square a corner, as an ordinary horse mower. No difficulty whatever was experienced in working on slopes, and all the grass was picked up cleanly. It was found that the machine could be modified for transport in about five minutes, and could then pass through a 9 feet 3 inch gap or gateway.

For four years the Cutlift has been the only equipment available for cutting and collecting short grass. Other machines are in course of development, but none has yet been used in the field on commercial work. The new Cutlift is a considerable improvement on the old and is likely to be the standard grass-collecting appliance for some time to come.

II. Oil-fired Sterilizing Plant. Halliday Boilers, Ltd., Selhurst, London. Price £34.

This outfit consists of an oil-fired boiler and sterilizing chest. The boiler is fired by a single Primus burner and enables sterilization to be carried out, in districts where electricity is not available, without the inconvenience of using coal or coke. It is claimed that the arrangement of cross tubes in the boiler leads to

very rapid steaming and that the addition of a special superheater ensures that sterilization is done with dry steam.

The test was carried out by the National Institute for Research in Dairying, whose report was as follows :—

"Tests were made under standard conditions when the following results were obtained :—

Boiler efficiency.	*Boiler capacity.*
72 per cent.	73 lb. of steam per hour.

Total operating times from cold to supply 10 gallons of hot water and effect sterilization (210°F. for 10 minutes) :—

Chest full of tinned steel utensils . .	51 mins.
Chest full of glass bottles	76 mins.

"The results show in all respects an exceptionally good performance, and no undue attention was necessary to air pumping and maintenance of water feed to obtain these results.

"The construction of the complete outfit appears satisfactory and no defects were apparent during the tests.

"The duration of the tests was insufficient to enable the effect of lumer carbonization or hard water deposit to be determined.

"The outfit has been submitted for the official test of the Ministry of Agriculture's Machinery Testing Scheme and subjected to extensive trials, and the results confirm the findings above."

This outfit is considered to have an exceptionally good performance and its advantages, in allowing high pressure steam to be used for sterilization in remote districts without the necessity for using coal, is likely to make it a very useful plant on dairy farms.

III. Drainage Trench Excavator. R. H. Neal & Co., Ltd., Ealing. Price, £1,350 *with petrol engine;* £1,425 *with diesel engine.*

This is a bucket-type tracklaying excavator similar to those used in laying telephone mains, etc., but adapted for agricultural purposes. The standard boom digs a maximum depth of four feet at widths of 12, 13½ or 15 inches. With special booms a maximum depth of 5 feet 6 inches can be reached, and narrower trenches, down to 8 inches, can be dug. The boom will dig straight down to start a trench and the depth of digging can be adjusted during work. The debris from the trench is delivered on to a reversible cross conveyor and can be delivered at various distances on either side of the trench as required. There are three digging speeds of 10, 4 and 2 lineal feet per minute respectively and three travelling speeds for transport purposes.

The digger was used to dig about 1,400 yards of trench, 2½ feet deep by 1 foot wide, in a gravel soil near Oxford. A length

of 500 yards was dug alongside a hedge with the inner edge of the trench about 3 feet from the hedgerow. The remaining 900 yards consisted of a main drain in midfield with three branches communicating with wet patches of land. The soil was in rather wet condition following heavy spring rain. The work alongside the hedge was very neatly done at an average rate of about 5½ feet per minute. The spoil was deposited between the drain and the hedgerow and a clean-cut finish was left.

Over most of the open field equally good work was done and in the lighter portions a speed of ten feet per minute was reached. In one of the wet patches, where conditions were exceptionally bad, the machine became bogged and had to be hauled out. During this period a small breakdown occurred necessitating repairs which were carried out by the operator. Afterwards the machine finished the work with the exception of a few yards in the wettest portion. Throughout the work only one man was required and he was able to control the machine and regulate the depth of working without difficulty.

The total working time for 1,400 yards of trench was about 12 hours.

Excluding time lost through the breakdown, the working costs for excavating the full 1,400 yards of trench were estimated at 6s. for fuel and oil and £1 for labour. No estimate of the overall costs can be given since no figures for depreciation of the machine are available. The overall cost, with a machine regularly employed on contract work would, however, almost certainly be appreciably less than that of hand labour.

This machine is thoroughly efficient and is likely to be of great service to agriculture.

UNSUCCESSFUL ENTRIES.

I. Grass Drying Equipment. Sir Bernard Greenwell, Bart., Marden Park, Woldingham. Price not stated.

This entry was deferred by the Judges of Implements at the Bristol Show and allowed to be re-entered in 1937.

In this drier the wet grass is dropped through the flame from a producer type coke furnace and is sucked, together with the hot gases from the furnace, and with additional air, through about 210 feet of 9-inch diameter metal piping. Two separate fans are provided, one about half-way along the pipe and the other at the far end. Each is driven by a 5-h.p. electric motor. An auxiliary furnace admits a further supply of hot gases at a distance of about 60 feet from the start. All the piping is totally enclosed in a lagged housing.

The grass is fed on to a slow-moving elevator which delivers it to a faster-moving cross elevator which, in turn, delivers it into the drier. The feeding mechanisms are driven by a one-h.p.

motor. At the far end the grass is passed through the second fan and a cyclone, and falls on to the ground. The time of passage through the drier is about 12 seconds.

The drier was operated by three men and was used to dry about half a ton of fresh-cut grass in two batches. Each batch was put through the drier three times. The results were as follows :—

		Batch No. I.	*II.*
Weight of wet grass	lb.	384	711
Moisture content of wet grass	per cent.	74·85	74·85
Total drying time (three stages)	minutes	37	60
Weight of dry grass	lb.	90	237
Moisture content	per cent.	14·88	26·75
Weight of water removed	lb.	294	474
Rate of water removal	lb. per hour	476	474

The only difference between these two tests was that, in the second, an attempt was made to raise the rate of feeding and therefore the output of the drier. This attempt was unsuccessful, for the rate of water removal was the same in both tests, and in the second test the material, after three passages through the drier, was still too wet for safe storage.

The material delivered by the drier was very uniform and the necessity which exists in all other driers for drying down to 4 or 5 per cent. moisture content in order to obviate danger from wet patches would probably not apply in this case. In these circumstances the final product in the first test (14·88 per cent. moisture content) can be regarded as having been sufficiently dry for safe storage.

On the basis of the first test the output of the drier was about 1¾ cwt. of dry grass per hour. On the basis (usually adopted with other driers) of a 4 : 1 water ratio the output would only be about 1 cwt. per hour.

Consumption of coke and electricity. Over a period of 3 hours 42 minutes, which included the 1 hour 37 minutes occupied by the two tests, together with 2 hours 5 minutes idle time, 165 lb. coke were consumed. Making no allowance for idle time, it can be deduced that 1 lb. coke evaporated 4·65 lb. water. Having regard to the long period of idle time, this figure compares fairly well with the figure given for other driers. During the second test 9·5 units of electricity were used : or 42·5 units per ton of water evaporated.

The drier had been considerably altered since the previous year and, owing to the duplication of fans and furnaces and the use of a much greater length of pipe, the first cost of the machine must have been considerably increased. There was no indication, however, that the output had been increased. That precisely the same rate of water removal occurred in two very different tests suggests that the output of the drier depends on

some simple factor like the cross-sectional area of the flame through which the grass passes, and that a very much simpler and less expensive machine could give substantially the same performance. At the moment the drier compares very unfavourably with other machines as regards output, and would be too expensive for practical use.

II. Bracken Breaker. Messrs. Harrison, McGregor & Co., Ltd., Leigh, Lancs. Price, £14 14*s.* (*varying according to size*).

This "machine" consists of a heavy square steel bar about 4-4½ feet long with end bearings fitted with shackles for attachment to a horse trace. The bar revolves when the implement is dragged. In order to conform to uneven ground, the 4-foot bar can be replaced by two half bars of 2 feet 3 inches in length, with double shackles to connect the central part, giving an overlap of 3 inches and again a total width of 4 feet. Bars are made of different square sections (4-5 inches) and lengths (4-5 feet) depending on the type of land and according as one or two horses, or a tractor, is to be used. The weight of the bars varies from 3 cwt. upwards.

Rocks form no serious impediment to the bar, but the half bars have the advantage that the horseman can free them from serious obstructions quite easily. The bar flattens down the bracken and bruises and breaks it so that it is destroyed. It also breaks developing fronds. In trials of the implement many of the fronds have been so injured that they have dried up a week later.

Attached to the bar are chains with weights; the chains are convenient for lifting one end of the bar over an obstruction, whilst the weights at the end of the chains help to prevent the bar from over-running the horse on downward slopes.

The machine is very simple and there are no knives to blunt or to be sharpened, while oiling is necessary at two or four points only. It can therefore be used by any farm horse and horseman and the speed is that of the horse and man. With a 4-foot machine the work done should be approximately 6-8 acres per day.

Old and "weedy" bracken is not so satisfactorily dealt with, and may require to be gone over twice in opposite directions. This would reduce the area cut. If the bracken is cut at the proper time, however, this should not be necessary.

Bracken eradication takes several years to accomplish, so that no definite information as to the ultimate effectiveness of this implement is yet available. The Consulting Engineer, however, had an opportunity of seeing the Holt machine working in Wales at the end of May on bracken-infested land which had previously had several years of treatment by cutting, and on

which about 80 per cent. clearance had already been accomplished. Under these conditions the Holt machine was not very successful: there were only two or three young fronds to the square yard, but very few of these were sufficiently crushed or damaged. Under the same conditions another machine was rather more successful, but the general impression formed was that, in the final stage of eradication, some kind of cutting device would be essential.

On the other hand the Holt appears to be effective in the earlier stages of eradication and can tackle steep slopes with boulders without much difficulty.

Since the implement did not clearly show any real superiority to other types of bracken-destruction implements, it did not, in the opinion of the judges, fulfil the conditions required to merit the award of a medal.

III. Cylinder Head Gasket. The Headen Keil Engineering Co., Ltd., Camberley. Price, £3.

The Gasket is made of a copper alloy and is of the same thickness as the standard composite gasket used in the particular engine concerned.

The gasket is of standard shape except that it extends into the compression space of each cylinder so as to form a flange between the top of the cylinder and the cylinder head. The purpose of this flange is to trap unevaporated fuel which would otherwise run down the cylinder walls, and to hold it until it is burnt off.

It is claimed that this gasket will prevent dilution of lubricating oil in paraffin-burning tractors.

The gasket has been tested under the Ministry of Agriculture's Machinery Testing Scheme, but the report has not yet been issued. It is not therefore possible to express an opinion on the results of the tests, but from information placed before the judges it appeared that no very striking reduction in total dilution would be secured, and that the performance of the gasket would hardly justify the award of a medal.

IV. Crude Oil Carburettor. The Headen Keil Engineering Co., Ltd., Camberley. Price, £25.

This is a device whereby a paraffin or petrol-engined tractor can be adapted to run on diesel oil. It consists of a float chamber and pre-heater which are fitted in conjunction with the standard carburettor of the tractor, and a special hot-plate which replaces the standard hot-plate. In operation the tractor, which must also be fitted with a Headen Keil Anti-dilution Gasket (see preceding entry), is started and warmed up on petrol through the ordinary carburettor. When the engine is sufficiently warm the petrol supply is cut off and the diesel oil supply is turned on.

The carburettor has been tested under the Ministry of Agriculture's Machinery Testing Scheme, but no report has yet been issued. The judges cannot therefore express an opinion on the results of this test either, but on information provided to them it was not considered that the carburettor had fulfilled the conditions which would have justified them in awarding a medal.

V. Hydraulic-Control Tractor Cultivator Attachment. Miller Wheels, Ltd., Chelsfield, Kent. Price, £33 10*s.*

This entry is a further development of the cultivator attachment which was awarded a Silver Medal at Ipswich in 1934. It consists of two transverse tool-bars which are carried behind the tractor and are connected to it through attachments to the rear axle and the front end of the crankcase. The rear axle attachment includes a hydraulic jack unit by which the tool bars can be raised and lowered and by which the depth of working can be regulated during work. The tool bars can be fitted with cultivator tines, hoes, ridging bodies or beet or potato lifters, and can either be locked so as to form a rigid unit or can be given a certain degree of lateral freedom so as to become a steerage implement. Steerage handles are provided and the steersman can either walk or ride on a seat at the rear of the implement.

The main difference between this entry and that of 1934 is the use of a hydraulic jack for lifting purposes.

The cultivator was tested by the Institute for Research in Agricultural Engineering and the test covered work (with a Fordson tractor) both as a rigid cultivator on fallows and as a steerage tractor-hoe on sugar beet and mangolds. The work on fallows was satisfactory but did not differ essentially from that which would be done by any tractor cultivator.

For sugar beet hoeing the tool bars were fitted with 10-inch *L* hoes so as to cover four complete 18-inch rows together with half a row on each side. The hoes were flexibly mounted so that each was free to rise and fall against a spring, independently of the main frame. With this type of hoe mounting, all the hoe stems are mounted on the front bar with the corresponding guide stems on the rear bar. The arrangement would not be entirely satisfactory in a very weedy crop because of lack of clearance between adjacent hoes.

The time taken by two men to attach the unit to a Fordson tractor and equip it for hoeing was :—

Fitting and attaching frame and pneumatic lift	1 hour
Fitting hoes and adjusting to correct spacing . . .	1½ hours
Fitting special Miller Wheels (to adapt the tractor to the rows)	2 hours
Total time	4½ hours

The unit was worked as a steerage implement by two men on sugar beet and mangolds at two stages of growth and its

performance was compared with that of the horse-hoe equipment normally used on the same farm. The soil was in a fair state of tilth but inclined to set after heavy rain. Most of the weeds were annuals. The hoeing was quite as good as that of the horse equipment, the weeds being cleared just as close to the rows without covering any plants with soil. The rate of work with two men was rather more than double that of the 2½-row horse-hoe worked by a man and a boy.

The average time taken to lift the implement at the headlands was 31 seconds and a full lift required 132 strokes of the pump handle. The lowering is instantaneous.

The general work of this outfit was quite satisfactory. The novelty of the entry, however, consists almost entirely in the hydraulic lifting mechanism and, while this was quite effective, it was too slow in operation and compared unfavourably with that of various power-lift devices which are available. In practice a complete stop of over half a minute at the end of each bout would be unsatisfactory.

VI. Clod Cutter. J. C. & T. Yates, Doncaster. Price, £20.

The machine consists of 15 steel blades, each 2½ inches deep, set radially in three spiders to form a skeleton roller. Two such rollers on a common shaft make up a complete horse unit of 7 feet 3 inches width. Trays for adding additional weight are provided, and for transport the whole implement can be turned over on to two cast-iron wheels.

The implement was tested by the Institute for Research in Agricultural Engineering and was used in the preparation of land for root crops after heavy spring rain. The soil was lower greensand and was inclined to set hard and cloddy. The implement was tried over a wide range of soil moisture contents from very wet to bone dry; and on land in various stages of cultivation from a rough ploughed condition onwards. The trays were weighted with pig iron, varying amounts up to a maximum of 18 cwt. being used.

On moist land the cutter worked best with an added weight of 10 cwt., but difficulties were experienced through the spaces between the blades becoming packed with soil. The limits of moisture-content between which the machine was effective without clogging were very narrow; and even under the most favourable conditions the pulverization was not as thorough as was done on the same land by a Cambridge roller. In the machine supplied for test the blades were set at about 5-inch intervals, and too much clod was left even after two workings. It is possible that better work would have been done if the blades had been set closer together, but at the same time difficulties due to packing with soil would have been increased. On rough ploughed dry land the cutter was quite ineffective.

On the whole the machine's only advantage appeared to be that the surface was left less consolidated than after a roller, so that if further drying out had been necessary the implement would have tended to facilitate this.

Under the conditions of test the implement appeared to have no advantages over various others that are available. It may be more effective elsewhere, but it is considered that its application will always be very limited.

VII. Cream Separator. The Wolseley Sheep Shearing Machine Co., Ltd., Birmingham. Price, £30.

The only new feature of this entry is that, unlike all other electrically-driven separators, it uses a high-speed motor and a single Vee-belt drive, so that all intermediate gearings are eliminated.

The motor is of the capacitator type and requires no slipping clutch. It can be simply switched on, and will run gradually and smoothly up to speed. It is claimed that the consumption of electricity is very low.

The test was carried out by the National Institute for Research in Dairying and the following report was submitted :—

" A short test was carried out and measurements of bowl speed, power factor and power consumption were made. No tests were made using milk, but for purposes of obtaining load and no-load speeds water was used.

Power consumption.			*Bowl speeds.*	
Starting load	Running load	Power factor	No load	Load
640 watts	176 watts	9·5	8,800 r.p.m.	8,700 r.p.m.

" The power factor approaches unity and shows very efficient performance of the motor. The power consumption is extremely low, being at least 50 per cent. less than geared machines of equal capacity. The construction of the machine is good. The claims of the entrants appear to be fully substantiated."

The separator operated satisfactorily and the entrants' claim of a lower power consumption was fully substantiated. Power consumed in separating, however, is not a very serious charge in the production of cream and butter, and the machine was not therefore considered to have fulfilled the conditions necessary to justify the award of a medal.

VIII. Horse and Cattle Clipper. The Wolseley Sheep Shearing Machine Co., Ltd., Birmingham. Price, £9 17*s.* 6*d.*

This is a very neat arrangement of electric motor, flexible drive and clipper head in which the motor is strapped to the back of the operator. It is said to have the advantages—

(*a*) that it is more adaptable than a clipping machine in which the motor is suspended overhead or mounted on a stand; and

(*b*) that it is superior to those machines in which the motor is mounted on the hand piece, both in being lighter to operate and because no vibration is transmitted to the animal which is being clipped.

The clipper can be removed and an adjustable chuck substituted. The outfit can then be used as an electric drill or to operate a grinding or polishing wheel.

The clipper was used for a period of six weeks to do all the clipping necessary in an Oxford riding stable. It operated satisfactorily at all times and, in the opinion of the manager of the stable, the entrants' claims were substantiated.

This is a very neat and well-constructed clipper which is likely to be more convenient in practice than those of ordinary type. When the chuck is fitted its possible uses with small tools would make it a very useful implement on the small farm.

In the opinion of the judges, however, it did not exhibit a sufficient degree of novelty, compared with other existing types of clipper, to justify the award of a medal.

Deferred Entries.

I. Grass Drier. Messrs. Mobile Driers, Ltd., Newcastle-upon-Tyne. Price, £950.

This drier resembles a threshing box in external appearance and can be transported from field to field or from farm to farm. The furnace, power transmission and fan are mounted on one rubber-tyred chassis, and the drier proper on another. The grass is conveyed through the drier on six superposed travelling conveyors, and during its passage through the machine it cascades from each conveyor in turn to the one immediately below. This obviates the necessity for intermediate tedding. It is claimed that drying is done by radiant heat rather than by direct contact with hot air. The drier contains 96 radiant heat panels each in the form of a rectangular tube fitted transversely between the conveyors. Furnace gas at a temperature of 300°F. is circulated by a fan through these panels and afterwards escapes through small holes in their under surface. Temperatures are recorded electrically at two points: at the inlet and at a point above the grass on the lowest belt. The degree of dryness is indicated by the difference between these temperatures and, if the product should be not satisfactory, the speed of the conveyors can be adjusted by a reduction gear.

A test, in which the fan and conveyor were driven by a steam traction engine, was carried out by the staff of the Armstrong

College, Newcastle-on-Tyne. The start was delayed on two occasions: first by the breakage of a casting in the drier, and secondly by a fire inside the machine which, however, did little damage. Eventually a test of four hours twenty-six minutes duration was carried out but, although the drier operated successfully, inexperience on the part of the men feeding the machine led to a very uneven product. The Judges felt that the drier had been assembled rather hurriedly in order to be ready for their inspection and that further trials were necessary, both to eliminate some small defects and to determine the rate of feeding that would give a uniformly dry product. They therefore deferred the entry for further consideration at the next Show.

II. Thatching Needle. John H. Darby, Rugby. Price, Needle £1 1s.; reel 2s. 6d.

This entry consists of a sickle-shaped steel needle pointed at one end and having an eye to take the twine.

A bracket is attached to the other end of the needle and through this passes a straight-pointed spear. The spear is free to slide through the bracket and is held firm by means of a flat steel spring. The point of the spear has a slotted hook. Specially designed twine reels, with a hook at one end for attaching to the ladder or roof of the stack, can be purchased.

In using the needle the thatch is placed on the roof in the usual manner. The spear is pulled out to the full extent and the twine placed in the slots across the eye of the needle, leaving plenty of slack twine on either side. The starting position is with the handle pointing straight up the roof, lying close against the thatch, and the point of the needle towards the thatch.

The curved needle is pushed well into the roof at a point where the stitch is required and is then turned back until the handle is in a horizontal position. The spear is then pushed right home and, being afterwards withdrawn to the full extent, brings back a loop of twine on its hook. This loop is slipped off the hook, and the needle is withdrawn and laid aside until required for the next stitch. The loop is then pulled to tighten the right hand twine and is secured.

This entry had been tested under the Ministry of Agriculture's Testing Scheme and the report of this test was available. The Judges did not have an opportunity of seeing the needle demonstrated in the Showyard, and it was therefore deferred for further consideration at the next Show.

It will be observed that the ratio of successful entries to unsuccessful was low, but it must be emphasized that the judges' decisions were determined entirely by the merits of the entries themselves. Had they been fully satisfied that the unsuccessful

entries completely fulfilled the conditions which justify the award of a medal, additional awards would have been made.

I feel that I should acknowledge the assistance which both my fellow judge and myself have received, in carrying out a task which becomes heavier and more complicated as time goes on, both from the Society's Consulting Engineer and from those Institutes and individuals who have been good enough to simplify our task by conducting tests of the entries.

THOMPSON CLOSE.

Welbourn,
Lincs.

REPORT OF THE STEWARD OF DAIRYING, WOLVERHAMPTON SHOW, 1937.

MILK YIELD TRIALS.

CATTLE, CLASSES 222 to 232.

THE Milk Yield Trials differed from those of 1936 in that all the cattle were thrice milked—at 6 a.m., 1 p.m., and 8 p.m. There was a good entry of a hundred cows, of which 72 actually competed.

Only three Dairy Shorthorns were forward and their performance was scarcely up to the usual standard for the breed. Nine Lincoln Reds, however, made an excellent showing. The first prize winner was Messrs. John Evens and Son's "Burton Red Rose 10th," a five-year-old, which gave over eight gallons with an average butter fat test of 3·66 per cent. This cow took second place, on points, among all the entries, being beaten by the narrowest of margins by the leading Guernsey and very closely followed by the winning Friesian.

The performance of the Red Polls was rather mixed, but the winner, Miss M. H. Bouverie's "Melton Mangrove," topped six gallons and had the excellent figure of 4·47 per cent. for butter fat.

There were only three South Devons, and none of these approached the high yields that the breed has achieved in some former years.

Friesians, as usual, included many eight- and nine-gallon cows, but an exceptionally large number fell below the 3 per cent. standard for butter fat, and were disqualified under the rules. Mr. James Kilpatrick's "Craigiemains Lady Evelyn" led with a yield of 88 lb.

There was little between the best and the worst of four Ayrshires, the poorest yield being 65¾ lb. at 3·8 per cent. butter fat.

TABLE I.—MILK YIELD CLASSES AT WOLVERHAMPTON, 1937.

Catalogue No.	Exhibitor.	Name of Cow.	Date of Birth.	Date of last Calf.	No. of days in Milk.	Date of last Service.	Milk Yield. Morning. Lb.	oz.	Noon. Lb.	oz.	Evening. Lb.	oz.	Total. Lb.	oz.	Average Fat percentage.	Points. Milk.	Fat over 3 per cent. × 10.	Lactation.	Service.	Total.	Awards and Remarks.
				1937		1937															
		Dairy Shorthorn.																			
Class 222																					
1179	J. Pierpont Morgan.	Aldenham Destiny 11th	Apr. 4, 1931	June 5	30	—	23	4	18	4	17	4	58	12	3·83	58·75	8·30	Nil	Nil	67·05	Second Prize
1187	Mrs. K. Hollas	Sherfield Waterloo Glitter	June 20, 1932	June 18	17	—	28	8	22	8	22	0	73	0	2·26	73·00	—	Nil	Nil	73·00	Fat below standard
1195	J. Pierpont Morgan.	Aldenham Lady Barrington 2nd	Oct. 2, 1932	April 22	74	—	25	0	22	8	20	4	67	12	3·00	67·75	—	3·40	Nil	71·15	First Prize
		Lincolnshire Red Shorthorn.																			
Class 223																					
1265	F. Russell Wood	Bendish Gem 22nd	Aug. 9, 1933	May 23	43	June 20	25	4	15	0	15	0	55	4	3·46	55·25	4·60	·30	Nil	60·15	H.C.
1266	Mrs. J. Bowser	Scothern Molly 4th	Apr. 21, 1929	May 16	50	—	27	0	19	0	18	8	64	8	3·86	64·50	8·60	1·00	Nil	74·10	Fifth Prize
1267	Chivers & Sons, Ltd.	Bendish Bride 15th	July 19, 1931	May 13	53	—	32	0	21	12	21	0	74	12	3·60	74·75	6·00	1·30	Nil	82·05	Third Prize.
1270	Chivers & Sons, Ltd.	Histon Fanny 12th	May 1, 1932	June 8	27	—	27	0	19	8	19	8	66	0	3·94	66·00	9·40	Nil	Nil	75·40	Fourth Prize
1271	John Evens & Son.	Burton Red Rose 10th	Jan. 8, 1932	May 31	35	—	33	4	24	12	23	12	81	12	3·66	81·75	6·60	Nil	Nil	88·35	First Prize
1273	John Evens & Son	Burton Ruby Spot 32nd	Sept. 21, 1931	June 4	31	—	28	0	19	8	18	8	66	0	3·20	66·00	2·00	Nil	Nil	68·00	Reserve
1275	F. Russell Wood	Bendish Cherry 37th	Sept. 9, 1930	June 13	22	—	27	8	15	0	20	8	63	0	2·83	63·00	—	Nil	Nil	63·00	Fat below standard
1278	John Evens & Son.	Burton Royal Starlight 17th	May 10, 1933	June 4	31	—	35	4	23	0	20	12	79	0	3·37	79·00	3·70	Nil	Nil	82·70	Second Prize
1281	F. Russell Wood	Bendish Nancy 32nd	Oct. 2, 1933	May 26	40	—	18	0	15	0	12	8	45	8	3·03	45·50	·30	Nil	Nil	45·80	Insufficient points
		South Devon.																			
Class 224																					
1308	John T. Dennis	Winsor Snowdrop 5th	Mar. 19, 1932	Feb. 13	142	June 1	21	4	16	8	16	8	54	4	3·63	54·25	6·30	10·20	Nil	70·75	First Prize
1310	George Wills.	Milkmaid 4th	Sept. 10, 1930	May 4	62	—	21	0	11	12	13	0	45	12	3·67	45·75	6·70	2·20	Nil	54·65	Insufficient points
1311	George Wills.	Primula 9th	Jan. 7, 1932	May 1	65	—	25	12	14	4	15	8	55	8	4·09	55·50	10·90	2·50	Nil	68·90	Second Prize
		Red Poll.																			
Class 225																					
1357	Balcombe Estates, Ltd.	Glevering Siskin	Sept. 21, 1931	May 21	45	—	28	0	22	4	21	4	71	8	3·03	71·50	·30	·50	Nil	72·30	Second Prize
1359	Lt.-Col. R. C. Batt, O.B.E., M.V.O.	Gresham Rachel	Feb. 25, 1928	June 1	34	—	19	4	14	12	14	0	48	0	3·65	48·00	6·50	Nil	Nil	54·50	Insufficient points
1368	Lord Cranworth.	Grundisburgh Good Duck	July 22, 1929	Mar. 18	109	—	15	0	9	4	14	4	38	8	3·48	38·50	4·80	6·90	Nil	50·20	Insufficient points
1372	Exors. of Walter Scrimgeour	Wissett Nonsuch	June 16, 1928	Mar. 6	121	May 25	17	8	14	0	12	8	44	0	4·55	44·00	15·50	8·10	·10	67·70	Third Prize
1375	Miss M. H. Bouverie, O.B.E.	Melton Mangrove	Mar. 7, 1932	Apr. 10	86	—	25	8	18	8	18	0	62	0	4·47	62·00	14·70	4·60	Nil	81·30	First Prize
1376	Lt.-Col. Sir Merrik R. Burrell, Bt., C.B.E.	Knepp Minerva 23rd	June 24, 1932	June 3	32	—	21	8	15	8	14	8	51	8	3·26	51·50	2·60	Nil	Nil	54·10	Insufficient points
1383	Mrs. Henry D. Lewis	Chipstead Iolaire	Mar. 13, 1932	Apr. 22	74	—	21	8	14	0	14	8	50	0	3·54	50·00	5·40	3·40	Nil	58·80	Fourth Prize
1387	Stuart Paul	Kirton Oaken	Nov. 5, 1932	May 6	60	June 23	28	0	20	8	16	8	65	0	2·58	65·00	—	2·00	Nil	67·00	Fat below standard
		Blue Albion.																			
Class 226																					
1438	C. H. Goodwin	Crystal of Crossfields	Oct. 1933	June 12	23	—	17	8	14	0	13	12	45	4	4·49	45·25	14·90	Nil	Nil	60·15	First Prize
1440	C. H. Webster	Ivonbrook Jewel	Oct. 24, 1933	May 20	46	—	14	8	14	4	13	0	41	12	4·22	41·75	12·20	·60	Nil	54·55	Second Prize

TABLE I.—MILK YIELD CLASSES AT WOLVERHAMPTON, 1937 (*continued*).

Catalogue No.	Exhibitor.	Name of Cow.	Date of Birth.	Date of last Calf.	No. of days in Milk.	Date of last Service.	Milk Yield. Morning.	Milk Yield. Noon.	Milk Yield. Evening.	Milk Yield. Total.	Average Fat percentage.	Points. Milk.	Points. Fat over 3 per cent. × 10.	Points. Lactation.	Points. Service.	Points. Total.	Awards and Remarks.
				1937		1937	Lb. oz.	Lb. oz.	Lb. oz.	Lb. oz.							
Class 227		British Friesian.															
1495	Cecil Ball	Ladywood Dainty 4th	Mar. 7, 1930	June 14	21	—	33 0	29 8	25 8	88 0	2·89	88·00	—	Nil	Nil	88·00	Fat below standard
1497	J. H. Brown	Marshgreen Kathleen	Sept. 6, 1929	June 12	23	—	29 12	20 4	21 12	71 12	4·43	71·75	14·30	Nil	Nil	86·05	Second Prize
1499	W. Curtis & Son	Abingworth Graceful	Oct. 11, 1931	June 8	27	—	32 0	28 4	26 12	87 0	2·61	87·00	—	Nil	Nil	87·00	Fat below standard
1500	W. Curtis & Son	Ingatestone Myrtle Dewdrop	Feb. 26, 1927	May 28	38	—	32 0	24 12	24 0	80 12	2·63	80·75	—	Nil	Nil	80·75	Fat below standard
1502	Capt. Harry Douglas	Farley Phyllis	Nov. 11, 1929	June 18	17	—	25 8	21 0	19 0	65 8	3·42	65·50	4·20	Nil	Nil	69·70	H.C.
1505	Bertram Parkinson	Creskeld Beatty Honeysuckle 2nd	Nov. 18, 1931	May 1	65	—	33 0	25 8	24 4	82 12	3·01	82·75	·10	2·50	Nil	85·35	Third Prize
1508	Strutt & Parker (Farms) Ltd.	Lavenham Chancery 6th	Dec. 2, 1930	June 11	24	—	28 8	22 4	22 4	73 0	3·99	73·00	9·90	Nil	Nil	82·90	Fourth Prize
1510	F. N. Terry	Chebbard Heather	May 22, 1929	Apr. 26	70	—	39 8	31 12	23 12	95 0	2·32	95·00	—	3·00	Nil	98·00	Fat below standard
1512	Arthur Barber	Chaddesden Mayblob 2nd	July 27, 1932	June 19	16	—	28 4	21 4	20 12	70 4	3·70	70·25	7·00	Nil	Nil	77·25	Fifth Prize
1518	F. W. Gilbert	Oulton Queen Bee	June 25, 1932	May 14	52	—	29 0	28 4	26 8	83 12	2·51	83·75	—	1·20	Nil	84·95	Fat below standard
1519	James Kilpatrick	Craigiemains Lady Evelyn	Mar. 27, 1933	June 22	13	—	32 12	27 12	27 8	88 0	3·02	88·00	·20	Nil	Nil	88·20	First Prize
1525	Albert Weightman	Herrington Naressa	Mar. 16, 1933	June 6	29	—	25 8	20 12	19 0	65 4	2·54	65·25	—	Nil	Nil	65·25	Fat below standard
1530	A. J. Creed	Goldicote (imp. 1936) Steenhuizen	Mar. 2, 1934	May 10	56	—	29 4	20 12	18 0	68 0	3·72	68·00	7·20	1·60	Nil	76·80	Reserve
Class 228		Ayrshire.															
1607	Edinburgh University (Institute of Animal Genetics)	Auchenbrain Miss Craig 67th	Mar. 4, 1930	May 28	38	—	27 0	22 0	21 4	70 4	3·63	70·25	6·30	Nil	Nil	76·55	Second Prize
1609	Edinburgh University (Institute of Animal Genetics)	Balgreddan Nessie	Oct. 17, 1930	May 29	37	—	26 12	21 0	22 0	69 12	3·34	69·75	3·40	Nil	Nil	73·15	Fourth Prize
1630	Robert Sillars & Son	Ickham Juno 4th	Oct. 5, 1931	June 6	29	—	25 4	21 4	19 4	65 12	3·80	65·75	8·00	Nil	Nil	73·75	Third Prize
1631	W. H. Slater	Findowrie Sonata	Oct. 31, 1929	May 11	55	—	33 0	22 4	20 4	75 8	3·52	75·50	5·20	1·50	Nil	82·20	First Prize
Class 229		Guernsey.															
1703	Mrs. Joan K. Bateson	Esperance 3rd of les Caches	June 26, 1932	June 21	14	—	19 12	15 0	14 0	48 12	5·19	48·75	21·90	Nil	Nil	70·65	Reserve
1704	W. Dunkels	Fernhill Rose 2nd	Mar. 28, 1928	June 11	24	—	19 8	12 12	12 0	44 4	4·14	44·25	11·40	Nil	Nil	55·65	H.C.
1705	H. A. Y. Dyson	Lenora's Polly of Cote Grange	May 6, 1930	Mar. 12	115	—	20 8	14 4	14 0	48 12	4·62	48·75	16·20	7·50	Nil	72·45	Fourth Prize
1706	H. A. Y. Dyson	Princess May des Landes Farm	Oct. 14, 1929	Apr. 25	71	—	30 8	16 8	15 12	62 12	3·30	62·75	3·00	3·10	Nil	68·85	H.C.
1710	G. F. Dee Shapland	Cis of North Valley	July 15, 1932	Feb. 20	135	May 11	21 0	14 12	14 8	50 4	4·80	50·25	18·60	9·50	1·50	79·85	Second Prize
1711	G. F. Dee Shapland	Claverham Daisy	Oct. 13, 1931	1936 Oct. 24	254	Feb. 11	15 0	10 8	11 0	36 8	4·79	36·50	17·90	12·00	10·40	76·80	Third Prize
1713	H. B. Turner	Plawhatch Kismet's Jasmine 2nd	June 7, 1932	1937 Apr. 12	84	May 25	21 8	15 0	14 4	50 12	4·00	50·75	10·00	4·40	·10	65·25	H.C.
1714	Mrs. Yorke	Peter's Asphodel	Feb. 5, 1931	June 1	34	—	33 4	22 8	21 8	77 4	4·14	77·25	11.40	Nil	Nil	88·65	First Prize
1716	Mrs. Yorke	Peter's Garland	May 1, 1932	Feb. 8	147	June 2	19 12	12 0	9 4	41 0	4·27	41·00	12·70	10·7	Nil	64·40	H.C.
1718	W. Dunkels	Fernhill Rose 8th	Mar. 29, 1933	May 18	48	—	20 8	17 0	15 12	53 4	4·68	53·25	16·80	·80	Nil	70·85	Fifth Prize
1722	Eric H. Rose	Leweston La Belle 3rd	Jan. 12, 1933	May 27	30	—	19 4	15 0	16 0	50 4	4·36	50·25	13·60	Nil	Nil	63·85	H.C.
1723	G. F. Dee Shapland	Claverham's Golden Lass	Feb. 22, 1933	Apr. 2	94	June 12	22 12	17 0	18 0	57 12	3·55	57·75	5·50	5·40	Nil	68·65	H.C.
1724	Mrs. Joan K. Bateson	Plaisance Lady	Nov. 14, 1933	May 14	52	—	16 8	14 8	13 12	44 12	3·58	44·75	5·80	1·20	Nil	51·75	H.C.
1734	Lord Swaythling	Lady Love 2nd of the Bouillon	Feb. 3, 1934	June 5	30	—	17 12	14 4	14 8	46 8	4·69	46·50	16·90	Nil	Nil	63·40	H.C.

Class 230		Jersey.															
1798	Miss Marjory G. Barrow	Wheatlands Jane	Oct. 16, 1929	Feb. 9	146	June 13	18 0	12 12	12 12	43 8	4·67	43·50	10·70	10·6	Nil	70·80	Fourth Prize
1805	Mrs. R. M. Foot . .	Carmel Clarinda	July 31, 1932	June 6	29	—	21 0	15 12	14 12	51 8	4·56	51·50	15·60	Nil	Nil	67·10	H.C.
1808	Mrs. A. M. Hall . .	Brockwood Bella Vista	July 3, 1931	Feb. 6	149	June 7	16 12	10 0	12 0	38 12	4·39	38·75	13·90	10·9	Nil	63·55	H.C.
1816	Sir John B. Lloyd. .	Foxbury Valentine 2nd . . .	June 11, 1931	May 3	63	—	20 4	17 0	15 12	53 0	4·43	53·00	14·30	2·30	Nil	69·60	Reserve
1817	A. S. Lockwood . .	Bessie	Apr. 19, 1930	May 15	1	—	27 4	22 12	20 12	70 12	3·79	70·75	7·90	1·10	Nil	79·75	Third Prize
1818	J. W. McCallum . .	Pearcelands Eileen 10th . . .	July 2, 1931	June 6	29	—	31 0	19 4	19 8	69 12	4·69	69·75	16·90	Nil	Nil	86·65	First Prize
1822	H. B. Mitchell . . .	Molly Sunflower 2nd	Mar. 25, 1933	Mar. 28	99	June 18	20 4	16 4	15 0	51 8	4·33	51·50	13·30	5·90	Nil	70·70	Fifth Prize
1823	Viscountess Monsell, C.B.E.	Dumbleton Guinea	Nov. 20, 1931	Feb. 14	141	—	20 12	14 12	14 12	50 4	5·21	50·25	22·10	10·10	Nil	82·45	Second Prize
1837	Wm. E. Press . . .	Diamond Buckle	May 14, 1932	Apr. 21	75	—	17 0	14 0	12 4	43 4	4·97	43·25	19·70	3·50	Nil	66·45	H.C.
1839	Ladies Constance Ryder and Audrey Anson	Maid o' the Moor	Sept. 15, 1931	Mar. 25	102	June 4	16 0	12 0	12 4	40 4	5·19	40·25	21·90	6·20	Nil	68·35	H.C.
Class 231		Kerry.															
1894	Mr. and Mrs. R. St. J. Bowen-Colthurst	Buckland Juno	Feb. 16, 1933	Jan. 20	166	Mar. 13	17 0	11 4	11 4	39 8	3·24	39·50	2·40	12·00	7·40	61·30	First Prize and Elmhurst Challenge Cup
1896	Newton R. Steel . .	Hookland Angela	Jan. 12, 1930	May 11	55	—	20 4	14 8	14 4	49 0	4·06	49·00	10·60	1·50	Nil	61·10	Second Prize and Reserve for Elmhurst Challenge Cup
Class 232		Dexter.															
1920	Mrs. Carlos Clarke . .	Grinstead Convolvulus 6th . .	May 1, 1933	May 6	60	—	16 0	10 8	10 4	36 12	3·70	36·75	7·00	2·00	Nil	45·75	Reserve.
1928	Lady Loder	Beenham Dora.	Oct. 3, 1932	Apr. 22	74	—	16 4	10 0	9 12	36 0	4·19	36·00	11·90	3·40	Nil	51·30	Second Prize and Reserve for Dexter Cattle Society's Challenge Cup
1929	Mrs. T. H. Peyton . .	Colomendy Sybil	Jan. 1, 1932	Mar. 12	115	June 14	17 0	11 4	10 8	38 12	3·12	38·75	1·20	7·50	Nil	47·45	Third Prize
1930	Mrs. T. H. Peyton . .	Thorp Dora	Feb. 26, 1928	Apr. 14	82	—	21 12	15 8	14 12	52 0	3·00	52·00	—	4·20	Nil	56·20	First Prize and Dexter Cattle Society's Challenge Cup

Mr. W. H. Slater's "Findowrie Sonata" took first place with 75½ lb. and 3·52 per cent. fat.

Guernseys produced the strongest class and it was noteworthy that all of the twelve cows were above the standard laid down for the Society's High Commendation. As already mentioned the winner, Mrs. Yorke's "Peters Asphodel," produced the highest number of points in the trials, giving 77¼ lb. of milk with a fat content of 4·14 per cent. The leading Jersey was only a little behind, giving 69¾ lb. of milk with 4·69 per cent. of fat.

The better of two Kerry cows was "Buckland Juno," which was nearly six months calved and touched her 4 gallons. The leading Dexter, Mrs. Peyton's "Thorp Dora," gave 52 lb.—a wonderful yield for her size.

Table II. gives the average figures for each breed.

TABLE II.—*Average Results in Milk Trial Classes.*

No. of Cows competing.	Breed.	Days in Milk.	Yield of Milk.	Fat percentage.	Total Points.
			Lb. oz.		
3	Dairy Shorthorn	40	66 8	3·06	70·40
9	Lincoln Red	37	66 3	3·44	71·06
3	South Devon	90	51 13	3·80	64·77
8	Red Poll	70	53 13	3·57	63·25
2	Blue Albion	34	43 8	4·36	57·35
13	British Friesian	35	78 6	3·14	82·30
4	Ayrshire	40	70 5	3·57	76·41
14	Guernsey	81	50 15	4·30	68·75
10	Jersey	88	51 4	4·62	72·54
2	Kerry	111	44 4	3·65	61·20
4	Dexter	98	40 14	3·50	50·17

BUTTER TEST TRIALS.

CLASSES 233 AND 234.

The first of the Butter Test Classes, for Guernsey, Jersey, Kerry and Dexter, attracted 30 entries of which 22 were forward, all belonging to the Channel Island breeds. One cow just failed to qualify under the butter-ratio rule and one other was a fraction of a point short of the number required for commendation. The remaining 20 all exceeded the number required. "Pearcelands Eileen 10th," which had won the Jersey Milk Yield class, again came to the top with a butter yield of fully 3½ lb. A Jersey was also second, but the remaining prizes went to Guernseys.

In the second class (for any other breed) the winner was Mr. J. H. Brown's "Marshgreen Kathleen," a Friesian, with a yield of nearly 3¼ lb. Messrs. John Evens & Son's Lincoln Red "Burton Red Rose 10th" was second, and an Ayrshire, shown

TABLE III.—RESULTS OF BUTTER TESTS AT WOLVERHAMPTON, 1937.

CLASS 233.—COWS OF GUERNSEY, JERSEY, KERRY OR DEXTER BREEDS.

No. in Catalogue	Exhibitor.	Name of Cow.	Date of Birth.	Date of last Calf.	No. of Days in Milk.	Date of last Service	Milk Yield in 24 hours.	Butter Yield.	Ratio, viz.: lb. milk to lb. Butter	No. of Points for Butter	No. of Points for Lactation.	No. of Points for Service.	No. of Points for Quality of Butter	Total No. of Points.	Awards and Remarks.
		Guernsey.		1937.		1937.	Lb. oz.	Lb. oz.							
1708	Mrs. Joan K. Bateson	Esperance 3rd of les Caches	June 26, 1932	June 21	14	—	48 12	2 7½	19·75	39·5	—	—	9·00	48·5	H.C. and E.G.C.S. Cert. of Merit.
1704	W. Dunkels	Fernhill Rose 2nd	Mar. 28, 1928	June 11	24	—	44 4	1 15¼	22·66	31·25	Nil	Nil	9·00	40·25	Insufficient points.
1705	H. A. Y. Dyson	Lenora's Polly of Cote Grange	May 6, 1930	Mar. 12	115	—	48 12	2 1	24·18	32·25	7·50	Nil	8·00	47·75	H.C. and E.G.C.S. Cert. of Merit.
1706	H. A. Y. Dyson	Princess May des Landes Farm	Oct. 14, 1929	April 25	71	—	62 12	2 1¼	30·18	33·25	3·10	Nil	8·00	44·35	Ratio over 30.
1710	G. F. Dee Shapland	Cis of North Valley	July 15, 1932	Feb. 20	135	May 11	50 4	2 5½	21·44	37·50	9·50	1·50	8·00	56·50	Fifth Prize and Reserve Fernhill Silver Chall'ge Cup.
				1936.											
1711	G. F. Dee Shapland	Claverham Daisy	Oct. 12, 1931	Oct. 24	254	Feb. 11	36 8	1 14½	19·14	30·50	12·00	10·40	9·00	61·9	Third Prize.
				1937.											
1713	H. B. Turner	Plawhatch Kismet's Jasmine 2nd	June 7, 1932	April 12	84	May 25	50 12	2 0½	24·98	32·50	4·40	·10	8·00	45·0	H.C. and E.G.C.S. Cert. of Merit.
1714	Mrs. Yorke	Peter's Asphodel	Feb. 5, 1931	June 1	34	—	77 4	3 1¼	25·09	49·25	Nil	Nil	8·00	57·25	Fourth Prize.
1716	Mrs. Yorke	Peter's Garland	May 1, 1932	Feb. 8	147	June 2	41 0	1 7½	27·91	23·50	10·70	Nil	8·00	42·20	H.C.
1718	W. Dunkels	Fernhill Rose 8th	Mar. 29, 1933	May 18	48	—	53 4	2 9½	20·53	41·50	·80	Nil	9·00	51·30	H.C. and E.G.C.S. Cert. of Merit, and Fernhill Silver Challenge Cup.
1722	Eric H. Rose	Leweston La Belle 3rd	Jan. 12, 1933	May 27	39	—	50 4	1 14½	26·36	30·50	Nil	Nil	9·00	39·50	H.C.
1723	G. F. Dee Shapland	Claverham's Golden Lass	Feb. 22, 1933	April 2	94	June 12	57 12	1 13¾	31·06	29·75	5·40	Nil	9·00	44·15	Ratio over 30.
1734	Lord Swaythling	Lady Love 2nd of the Bouillon	Feb. 3, 1934	June 5	30	—	46 8	2 2	21·88	34·0	Nil	Nil	9·00	43·0	H.C. and E.G.C.S. Cert. of Merit.
		Jersey.													
1798	Miss Marjory G. Barrow	Wheatlands Janie	Oct. 16, 1929	Feb. 9	146	June 13	43 8	1 14	23·20	30·0	10·60	Nil	9·00	49·60	H.C. and E.J.C.S. Cert. of Merit.
1805	Mrs. R. M. Foot	Carmel Clarinda	July 31, 1932	June 6	29	—	51 8	2 7½	20·85	39·50	Nil	Nil	8·00	47·50	H.C. and E.J.C.S. Cert. of Merit.
1808	Mrs. A. M. Hall	Brockwood Bella Vista	July 3, 1931	Feb. 6	149	June 7	38 12	1 8½	25·31	24·50	10·90	Nil	7·00	42·40	H.C.
1816	Sir John B. Lloyd	Foxbury Valentine 2nd	June 11, 1931	May 3	63	—	58 0	2 5½	22·61	37·50	2·30	Nil	7·00	46·80	H.C. and E.J.C.S. Cert. of Merit.
1817	A. S. Lockwood	Bessie	April 12, 1930	May 15	51	—	70 12	2 8¼	28·12	40·25	1·10	Nil	9·00	50·35	H.C. and E.J.C.S. Cert. of Merit.

TABLE III.—RESULTS OF BUTTER TESTS AT WOLVERHAMPTON, 1937.—*continued.*

CLASS 233.—COWS OF GUERNSEY, JERSEY, KERRY OR DEXTER BREEDS.—*Continued.*

No. in Catalogue	Exhibitor.	Name of Cow.	Date of Birth.	Date of last Calf.	No. of Days in Milk.	Date of last Service	Milk Yield in 24 hours.	Butter Yield.	Ratio, viz.: lb. milk to lb. Butter.	No. of Points for Butter.	No. of Points for Lactation.	No. of Points for Service.	No. of Points for Quality of Butter	Total No. of Points.	Awards and Remarks
		Jersey		1937		1937	Lb. oz.	Lb. oz.							
1318	J. W. McCallum	Pearcelands Eileen 10th	July 2, 1931	June 6	29		69 12	3 8¼	19·66	56·75	Nil	Nil	9·00	65·75	First Prize, Champion Gold Medal, and E.J.C.S. Gold Medal.
1322	H. E. Mitchell	Molly Sunflower 2nd	Mar. 25, 1933	Mar. 28	99	June 18	51 8	2 0	21·68	38·0	5·90	Nil	8·00	51·9	Reserve & E.J.C.S. Bronze Medal.
1323	Viscountess Monsell, O.B.E.	Dumbleton Guinea	Nov. 20, 1931	Feb. 14	141	—	50 4	2 12	18·27	44·0	10·10	Nil	9·00	63·10	Second Prize, Reserve for Champion Gold Medal, and E.J.C.S. Silver Medal.
1339	Ladies Constance Ryder and Audrey Anson	Maid o' the Moor	Sept. 15, 1931	Mar. 25	102	June 4	40 4	2 4	17·89	36·0	6·20	Nil	9·00	51·20	H.C. and E.J.C.S. Cert. of Merit.

CLASS 234.—COWS OF ANY BREED OTHER THAN THOSE MENTIONED IN CLASS 233.

No. in Catalogue	Exhibitor.	Name of Cow.	Date of Birth.	Date of last Calf.	No. of Days in Milk.	Date of last Service	Milk Yield in 24 hours.	Butter Yield.	Ratio, viz.: lb. milk to lb. Butter.	No. of Points for Butter.	No. of Points for Lactation.	No. of Points for Service.	No. of Points for Quality of Butter	Total No. of Points.	Awards and Remarks
		Dairy Shorthorn.		1937		1937	Lb. oz.	Lb. oz.							
1179	J. Pierpont Morgan	Aldenham Destiny 11th	April 4, 1931	June 5	80	—	58 12	2 0	29·37	32·0	Nil	Nil	7·00	39·0	Insufficient points.
1195	J. Pierpont Morgan	Aldenham Lady Barrington 2nd	Oct. 2, 1932	April 22	74	—	67 12	1 10½	40·89	26·50	3·40	Nil	5·00	34·90	Insufficient points.
		Lincolnshire Red Shorthorn.													
1265	F. Russell Wood	Bendish Gem 22nd	Aug. 9, 1933	May 23	43	June 20	55 4	1 5¼	41·60	21·25	·30	Nil	5·00	26·55	Insufficient points.
1266	Mrs. J. Bowser	Scothern Molly 4th	April 21, 1929	May 16	50	—	64 8	1 6½	45·84	22·50	1·00	Nil	4·00	27·50	Insufficient points.
1270	Chivers & Sons, Ltd.	Histon Fanny 12th	May 1, 1932	June 8	27	—	66 0	2 2	31·06	34·0	Nil	Nil	7·00	41·0	Ratio over 30.
1271	John Evens & Son	Burton Red Rose 10th	Jan. 8, 1932	May 31	35	—	81 12	3 0	27·25	48·0	Nil	Nil	8·00	56·0	Second Prize.
1273	John Evens & Son	Burton Ruby Spot 32nd	Sept. 21, 1931	June 4	31	—	60 0	1 13¼	36·10	29·25	Nil	Nil	3·00	32·25	Insufficient points.
1275	F. Russell Wood	Bendish Cherry 37th	Sept. 9, 1930	June 13	22	—	63 0	1 0½	61·08	16·50	Nil	Nil	8·00	24·50	Ratio over 30.
1278	John Evens & Son	Burton Royal Starlight 17th	May 10, 1933	June 4	31	—	79 0	2 7¼	32·20	39·25	Nil	Nil	7·00	46·25	Ratio over 30.
1281	F. Russell Wood	Bendish Nancy 32nd	Oct. 2, 1933	May 26	40	—	45 8	1 5	34·67	21·0	Nil	Nil	7·00	28·0	Ratio over 30.

	South Devon.														
George Wills .	Milkmaid 4th . .	Sept. 10, 1930	May 4	62	—	45	12	1	12¼	25·91	28·25	2·20	Nil	8·00	38·4	Insufficient points
	Red Poll.														
Exors. of Walter Scrimgeour	Wissett Nonsuch .	June 16, 1928	Mar. 6	121	May 25	44	0	1	11¾	25·36	27·75	8·10	·10	5·00	40·95	Insufficient points.
	Blue Albion.														
C. H. Webster .	Ivonbrook Jewel .	Oct. 24, 1933	May 20	46	—	41	12	1	10½	25·20	26·50	·60	Nil	8·00	35·10	Insufficient points.
	British Friesian.														
Cecil Ball. .	Ladywood Dainty 4th .	Mar. 7, 1930	June 14	21	—	88	0	1	11½	51·20	27·50	Nil	Nil	4·00	31·50	Ratio over 30.
J. H. Brown .	Marshgreen Kathleen .	Sept. 6, 1929	June 12	23	—	71	12	3	2¾	22·62	50·75	Nil	Nil	7·00	57·75	First Prize.
W. Curtis & Son	Abingworth Graceful .	Oct. 11, 1931	June 8	27	—	87	0	2	3½	39·20	35·50	Nil	Nil	7·00	42·5	Ratio over 30.
W. Curtis & Son .	Ingatestone Myrtle Dew-drop	Feb. 26, 1927	May 28	38	—	80	12	1	15½	41·01	31·50	Nil	Nil	8·00	39·50	Ratio over 30.
Bertram Parkinson .	Creskeld Beatty Honey-suckle 2nd	Nov. 18, 1931	May 1	65	—	82	12	2	6¾	34·17	38·75	2·50	Nil	7·00	48·25	Ratio over 30.
Strutt & Parker (Farms), Ltd.	Lavenham Chancery 6th .	Dec. 2, 1930	June 11	24	—	73	0	2	12	26·54	44·0	Nil	Nil	4·00	48·0	Fourth Prize.
F. N. Terry .	Chebbard Heather .	May 22, 1929	April 26	70	—	95	0	2	1	46·06	33·0	3·00	Nil	7·00	43·0	Ratio over 30.
Arthur Barber .	Chaddesden Mayblob 2nd .	July 27, 1932	June 19	16	—	70	4	2	0½	34·58	32·50	Nil	Nil	7·00	39·50	Ratio over 30.
F. W. Gilbert .	Oulton Queen Bee .	June 25, 1932	May 14	52	—	83	12	2	0½	41·25	32·50	1·20	Nil	8·00	41·7	Ratio over 30.
James Kilpatrick	Craigiemains Lady Evelyn .	Mar. 27, 1933	June 22	13	—	88	0	2	3½	39·94	35·25	Nil	Nil	2·00	37·25	Ratio over 30.
Albert Weightman	Herrington Naressa .	Mar. 16, 1933	June 6	29	—	65	4	1	2¾	55·67	18·75	Nil	Nil	7·00	25·75	Ratio over 30.
	Ayrshire.														
Edinburgh University (Institute of Animal Genetics)	Auchenbrain Miss Craig 67th	Mar. 4, 1930	May 28	38	—	70	4	2	10	26·76	42·0	Nil	Nil	7·00	49·0	Third Prize.
Edinburgh University (Institute of Animal Genetics)	Balgreddan Nessie .	Oct. 17, 1930	May 29	37	—	69	12	2	1¾	33·07	33·75	Nil	Nil	6·00	39·75	Ratio over 30.
W. H. Slater .	Findowrie Sonata .	Oct. 31, 1929	May 11	55	—	75	8	1	13¾	30·60	29·75	1·50	Nil	6·00	37·25	Ratio over 30.

by the Institute of Animal Genetics, Edinburgh University, came third. The average results, by breeds, are given below.

TABLE IV.—*Average Results of Breeds in Butter Tests.*

No. of Cows Competing.	Breed.	Days in Milk.	Yield of Milk.	Yield of Butter.	Butter Ratio.	Points.
			Lb. oz.	Lb. oz.	Lb.	
13	Guernsey . .	84	51 6	2 2¼	22·34	47·82
9	Jersey . .	90	52 2	2 6½	21·66	52·12
2	Dairy Shorthorn .	52	63 4	1 13¼	34.87	36·95
8	Lincoln Red .	35	65 2	1 13	35·93	35·26
1	South Devon .	62	45 12	1 12¼	25·91	38·40
1	Red Poll . .	121	44 0	1 11¾	25·36	40·95
1	Blue Albion .	46	41 12	1 10½	25·20	35·10
11	British Friesian .	34	80 8	2 2½	37·33	41·34
3	Ayrshire . .	43	71 13	2 3	32·83	42·00

MILK YIELD TRIALS—GOATS.

CLASSES 245 AND 246.

Thirty-seven goats competed in these trials and the details will be found in Table V.

WORKING DAIRY.

As in past years the working dairy received all the milk produced by cattle in the Show, separating the bulk and converting the cream into butter and cream cheese.

The butter-making competitions attracted 143 individual competitors, all of whom were ladies. Eight teams entered for the Inter-County Championship, which was won by the Herefordshire team, with Cornwall second and Staffordshire third.

The staff had, as usual, a vast amount of work to get through and deserve great praise for their energy, willingness and efficiency.

RICHARD H. EVANS.

Barclays Bank Chambers,
Pwllheli,
North Wales.

TABLE V.—MILK YIELD CLASSES FOR GOATS AT WOLVERHAMPTON, 1937.

CLASS 245.—QUALITY.

No. in Catalogue.	Exhibitor.	Name of Goat.	Breed.	Date of Birth.	Date of last Kid.	No. of days in Milk.	Milk Yield. Morn.	Milk Yield. Even.	Milk Yield. Total.	Percentage of Fat. Morn.	Percentage of Fat. Even.	Points. Milk.	Points. Fat.	Points. Lactation.	Points. Total	Deduction.	Net Total.	Awards and Remarks.
							Lb. oz.	Lb. oz.	Lb. oz									
1948	Miss H. M. Gresley Hall	Webb Demeter . .	British Toggenburg	Mar. 19, 1933	Mar. 8, 1936	491	6 14	5 13	12 11	3·7	4·0	12·68	9·76	3·60	26·04	—	26·04	Fourth Prize. Reserve for Dewar Cup with 1999.
1951	Mrs. Morcom . .	Cornish Frisky . .	British Toggenburg	Apr. 17, 1935	Mar. 8, 1937	121	7 13	10	14 7	2·9	3·5	14·43	9·24	1·20	24·87	1	23·87	Disqualified, under 3%
1952	Mrs. Morcom . .	Cornish Praline . .	British Toggenburg	Feb. 27, 1933	Feb. 24, 1937	133	9 11	8 12	18 7	3·5	4·2	18·43	14·19	1·30	33·92	—	33·92	First Prize and Dual Purpose Challenge Certificate
1953	Miss K. Parker .	Jacynth of Delamere	Saanen . . .	Jan. 31, 1933	Aug. 1, 1936	340	2 3	6	4 9	4·4	3·7	4·56	3·69	3·40	11·65	—	11·65	Disqualified, under 5½ lbs.
1954	Miss K. Parker . .	Jean of Delamere .	Saanen . . .	Jan. 24, 1933	Mar. 24, 1937	105	3 7	2 14	6 5	3·5	3·4	6·31	4·35	1·00	11·66	—	11·66	—
1955	Miss B. Skidmore .	Heddon Buttercup .	Saanen . . .	Mar. 4, 1932	Apr. 6, 1037	92	5 8	5 3	10 11	4·2	4·45	10·68	9·24	0·90	20·82	—	20·82	Commended
1957	Miss M. Window Harrison	Hartye of Weald	British Saanen.	Apr. 30, 1933	Apr. 8, 1937	90	8 6	7 8	15 14	2·7	2·6	15·87	8·41	0·90	25·18	2	23·18	Disqualified, under 3%.
1958	Miss M. Window Harrison	Humble of Weald	British Saanen .	May 26, 1934	Mar. 30, 1937	99	8 4	6 15	15 3	2·95	3·0	15·18	9·03	0·90	25·11	1	2 4·11	Disqualified, under 3%
1960	Mrs. Morcom . .	Cornish Urchinette .	British Saanen .	Mar. 18, 1934	Mar. 6, 1937	123	4 10	3 14	8 8	4·05	4·7	8·50	7·44	1·20	17·14	—	17·14	Reserve Chamberlain Cup
1961	Miss K. Parker . .	Silver of Delamere .	British Saanen .	Mar. 9, 1932	June 4, 1937	33	4 1	3 12	7 13	4·2	4·7	7·81	6·95	0·30	15·06	—	15·06	—
1963	Miss B. Skidmore .	Heddon Sandal .	British Saanen .	Apr. 6, 1932	Mar. 6, 1936	488	5 1	5 1	10 2	4·25	4·8	10·12	9·16	3·60	22·88	—	22·88	Reserve Chamberlain Cup
1969	J. R. Egerton . .	Didgemere Darkalette	British Alpine .	Mar. 25, 1934	Apr. 24, 1937	74	5 14	5 2	11 0	3·2	3·4	11·00	7·26	0·70	18·96	—	18·96	—
1972	Miss M. G. M. Madoc	Malverley Marguerite	British Alpine .	Apr. 19, 1936	Mar. 13, 1937	116	5 14	5 11	11 9	3·5	3·65	11·56	8·27	1·10	20·93	—	20·93	Commended
1973	Miss M. G. M. Madoc	Malverley Merrilees .	British Alpine .	Feb. 21, 1933	Ap 11, 1937	87	8 7	7 13	16 4	4·4	5·1	16·25	15·44	0·80	32·49	—	32·49	Third Prize. Reserve Abbey Cup
1974	Miss M. G. M. Madoc	Malverley Mistaken	British Alpine .	Mar. 7, 1934	May 1, 1937	67	8 3	7 15	16 2	4·9	4·9	16·12	15·80	0·60	32·52	—	32·52	Second Prize. Reserve Dual Purpose Challenge Certificate. Abbey Cup
1975	Mrs. Morcom . .	Cornish Pitch . .	British Alpine .	Feb. 18, 1933	Mar. 3, 1937	126	5 8	4 7	9 15	4·4	3·95	9·93	8·29	1·20	19·42	—	19·42	—
1976	Miss K. Parker . .	Stanway Susie . .	British Alpine .	Mar. 30, 1933	Apr. 29, 1937	69	5 4	5 3	10 7	4·0	3·6	10·43	7·93	0·60	18·96	—	18·96	—
1977	J. R. Egerton . .	Malpas Merrilegs .	Anglo Nubian .	May 27, 1935	Apr. 9, 1937	89	4 10	3 13	8 7	3·85	4·55	8·43	7·08	0·80	16·31	—	16·31	Reserve Pomeroy Cup
1978	J. R. Egerton . .	Malpas Merry . .	Anglo Nubian .	Feb. 4, 1934	Mar. 11, 1937	118	5 13	5 2	10 15	4·15	4·60	10·93	9·56	1·10	21·59	—	21·59	Highly Commended. Pomeroy Cup
1980	Miss B. Skidmore .	Moorhen	Anglo Nubian .	Mar. 19, 1934	Apr. 15, 1937	83	2 12	2 8	5 4	4·0	4·2	5·25	4·31	0·80	10·36	—	10·36	Disqualified, under 5½ lbs.
1981	Miss Alexander . .	Stockwell Tsuba .	British . . .	Jan. 19, 1935	Mar. 12, 1937	117	4 1	3 14	7 15	4·35	3·9	7·93	6·54	1·10	15·57	—	15·57	—
1982	Miss B. M. Gresley Hall	Webb Lettice . .	British . . .	Mar. 18, 1934	Mar. 10, 1937	119	6 5	5 12	12 1	4·0	3·9	12·06	9·53	1·10	22·69	—	22·69	Highly Commended
1983	Mrs. Morcom . .	Cornish Macedoine .	British . . .	Apr. 25, 1935	Mar. 16, 1937	113	5 12	4 15	10 11	3·9	4·1	10·68	8·54	1·10	20·32	—	20·32	Commended
1984	Mrs. Morcom . .	Cornish Playful . .	British . . .	Feb. 21, 1933	Apr. 11, 1936	452	6 4	5 5	11 9	3·7	3·75	11·56	8·61	3·60	23·77	—	23·77	Fifth Prize
1985	Mrs. Morcom .	Cornish Plover . .	British . . .	Mar. 23, 1935	Mar. 16, 1937	113	5 5	4 9	9 14	4·15	4·0	9·87	8·04	1·10	19·01	—	19·01	—

TABLE V.—MILK YIELD CLASSES FOR GOATS AT WOLVERHAMPTON, 1937.

CLASS 246.—QUANTITY.

No. in Catalogue.	Exhibitor.	Name of Goat.	Breed.	Date of Birth.	Date of last Kid.	No. of days in Milk.	Milk Yield. Morn.	Milk Yield. Even.	Milk Yield. Total.	Points. Milk.	Points. Fat.	Points. Lactation.	Points. Total.	Points. Deduction.	Points. Net Total.	Awards and Remarks.
							Lb. oz.	Lb. oz.	Lb. oz.							
1948	Miss E. M. Gresley Hall	Webb Demeter	British Toggenburg	Mar. 19, 1933	Mar. 3, 1936	491	6 14	5 13	12 11	12·08	—	3·60	16·28	—	—	Fifth Prize
1951	Mrs. Morcom	Cornish Frisky	British Toggenburg	Apr. 17, 1935	Mar. 8, 1937	121	7 13	6 10	14 7	14·43	—	1·20	15·63	—	—	Highly Commended
1952	Mrs. Morcom	Cornish Praline	British Toggenburg	Feb. 27, 1933	Feb. 24, 1937	133	9 11	8 12	18 7	18·43	—	1·30	19·73	—	—	First Prize
1953	Miss K. Parker	Jacynth of Delamere	Saanen	Jan. 31, 1933	Aug. 1, 1936	340	2 3	2 6	4 9	4·56	—	3·40	7·96	—	—	Disqualified, under 5½ lbs.
1955	Miss E. Skidmore	Heddon Buttercup	Saanen	Mar. 4, 1932	Apr. 6, 1937	92	5 8	5 3	10 11	10·68	—	0·90	11·58	—	—	—
1957	Miss M. Window Harrison	Hartye of Weald	British Saanen	Apr. 30, 1933	Apr. 8, 1937	90	8 6	7 8	15 14	15·87	—	0·90	16·77	—	—	Third Prize. Dewar Cup with 1938.
1958	Miss. M. Window Harrison	Humble of Weald	British Saanen	May 26, 1934	Mar. 30, 1937	99	8 4	6 15	15 3	15·18	—	0·90	16·08	—	—	Reserve
1960	Mrs. Morcom	Cornish Urchinette	British Saanen	Mar. 18, 1934	Mar. 6, 1937	123	4 10	3 14	8 8	8·50	—	1·20	9·70	—	—	—
1961	Miss. K. Parker	Silver of Delamere	British Saanen	Mar. 9, 1932	June 4, 1937	33	4 1	3 12	7 13	7·81	—	0·30	8·11	—	—	—
1963	Miss E. Skidmore	Heddon Sandal	British Saanen	Apr. 6, 1932	Mar. 6, 1936	488	5 1	5 1	10 2	10·12	—	3·60	13·72	—	—	Commended
1969	J. R. Egerton	Didgemere Darkalette	British Alpine	Mar. 25, 1934	Apr. 24, 1937	74	5 14	5 2	11 0	11·00	—	0·70	11·70	—	—	—
1972	Miss M. G. M. Madoc	Melverley Marguerite	British Alpine	Apr. 19, 1935	Mar. 13, 1937	116	5 14	5 11	11 9	11·56	—	1·10	12·66	—	—	Commended
1973	Miss M. G. M. Madoc	Melverley Merrilees	British Alpine	Feb. 21, 1933	Apr. 11, 1937	87	8 7	7 13	16 4	16·25	—	0·80	17·05	—	—	Second Prize
1974	Miss M. G. M. Madoc	Melverley Mistaken	British Alpine	Mar. 7, 1934	May 1, 1937	67	8 3	7 15	16 2	16·12	—	0·60	16·72	—	—	Fourth Prize
1975	Mrs. Morcom	Cornish Pitch	British Alpine	Feb. 18, 1933	Mar. 3, 1937	126	5 8	4 7	9 15	9·93	—	1·20	11·13	—	—	—
1976	Miss K. Parker	Stanway Susie	British Alpine	Mar. 30, 1933	Apr. 29, 1937	69	5 4	5 3	10 7	10·43	—	0·60	11·03	—	—	—
1978	J. R. Egerton	Malpas Merry	Anglo Nubian	Feb. 4, 1931	Mar. 11, 1937	118	5 13	5 2	10 15	10·93	—	1·10	12·03	—	—	Commended
1980	Miss E. Skidmore	Moorhen	Anglo Nubian	Mar. 19, 1934	Apr. 15, 1937	83	2 12	2 8	5 4	5·25	—	0·80	6·05	—	—	Disqualified, under 5½ lbs.
1982	Miss E. M. Gresley Hall	Webb Lettice	British	Mar. 18, 1934	Mar. 10, 1937	119	6 5	5 12	12 1	12·06	—	1 10	13·16	—	—	Commended
1983	Mrs. Morcom	Cornish Macedoine	British	Apr. 25, 1935	Mar. 16, 1937	113	5 12	4 15	10 11	10·68	—	1·10	11·78	—	—	—
1984	Mrs. Morcom	Cornish Playful	British	Feb. 21, 1933	Apr. 11, 1936	452	6 4	5 5	11 9	11·56	—	3·60	15·16	—	—	Highly Commended
1985	Mrs. Morcom	Cornish Plover	British	Mar. 23, 1935	Mar. 16, 1937	113	5 5	4 9	9 14	9·87	—	1·10	10·97	—	—	—

THE EDUCATION EXHIBIT AT THE WOLVERHAMPTON SHOW, 1937.

THREE sites were offered by the Society for the purpose of an educational exhibit, and that which was finally chosen in September, 1936, formed a rectangle about half-an-acre in extent, lying on one of the main avenues not far from the horse ring. This site was fenced off with paling and wire netting straight away, so that immediate progress could be made with the growing crops it was intended to exhibit.

The exhibit itself was the joint effort of the Agricultural Education Committees of the counties of Staffordshire, Shropshire, Warwickshire and Worcestershire, the Harper Adams Agricultural College, the National Institute of Poultry Husbandry, and Studley College. The Ministry of Agriculture provided the pavilion, made out the labels and staged the exhibits within the pavilion so as to achieve uniformity. Mr. H. B. Tilley, of the Staffordshire Farm Institute, acted as co-ordinating secretary.

The general outlines of the scheme were decided in September, 1936, by a small committee. It was unanimously decided that an open pavilion was preferable to one totally enclosed, and that the scheme adopted for the Warwick Show in 1931 was a good one to follow. The completed exhibit consequently took the form of a rectangle of open land, bordered on two sides by a lofty, open pavilion surmounted by a striking frieze of art panels depicting various rural activities. These panels were designed and prepared by the Art Schools of Staffordshire at Bilston, Burton-on-Trent, Leek, Lichfield, Newcastle-under-Lyme, Stafford, Stoke-on-Trent, Walsall, West Bromwich and Wolverhampton. They attracted a great deal of interested attention and were much admired; there can be little doubt that this re-union of fine art with agriculture was a wise and fruitful policy.

The outside exhibits comprised growing plants almost exclusively. Living animals were not included on account of the difficulties of housing them satisfactorily. Many of the beds were planted in the autumn of 1936, and it soon became evident that the site might be well placed but that the soil was most unsuitable. Despite soil fumigation, considerable trouble from wireworm was experienced, and the poverty of the soil was almost incredible. Naturally, this affected to some degree the various demonstrations, particularly winter cereals, but by the following July these disadvantages had been pretty well overcome.

OUTSIDE EXHIBITS.

Horticulture.—The central beds were devoted to horticultural demonstrations, including one on different varieties of lettuces most suited to local conditions, and another showing varieties of culinary peas suitable for canning. A large number of herbs used in the flavouring of foods, for drying or for medicinal purposes, was shown growing, and another collection consisted of plants useful to the apiarist in supplying nectar to his bees.

Occupying a strip along most of one side of the cultivated area was a demonstration orchard designed to indicate the best methods of starting a fruit orchard in the Midlands. Further down, under a large oak, was a collection of plants which can be recommended for shady conditions.

Farm Crops.—The rest of the outside exhibit was concerned with various problems affecting all sorts of farm crops, including grass.

Soil Acidity.—One of the most striking sections was that devoted to the relation of soil acidity to the growth of farm crops. This had a special appeal in view of the recently announced Government schemes concerning lime and slag. The demonstration took the form of a series of 32 small plots each about one yard square. The soil in each of these plots had been excavated to a considerable depth and replaced with soil of a known hydrogen-ion concentration: the preparation of these plots involved the carting on to the Show ground of nearly 20 tons of soil from different parts of the surrounding country. The plots were arranged in four lines of eight, and the pH varied from approximately 4.0, by easy stages, to approximately 6.5; in other words, from a strongly acid to a non-acid condition. Potatoes, sugar-beet, barley and oats were planted, one crop to each of the four series, so as to demonstrate the effect of increasing acidity on the growth of these different crops. It was clearly shown that for barley and sugar-beet the critical point of acidity is between a pH range of from 5.1—5.3, whilst potatoes and oats are able to endure more acid conditions, since they did not show signs of acute distress until the pH had reached from 4.0—4.3.

Close to these plots were a couple of small beds demonstrating the "grey speck" complaint in oats due to a deficiency of manganese in the soil. In the Midlands this disease has been noticed during the last few years on some fairly extensive areas of soil consisting of a humus-sand. The beds were filled with soil of this nature, taken from a farm on which grey speck had been observed. One bed had been heavily limed, whilst the other had not been limed. On the limed soil the disease was very obvious, on the other bed there was no disease. The object of the demonstration was to show that on soils of this humus-sand type lime in excess of the lime requirement should not be applied,

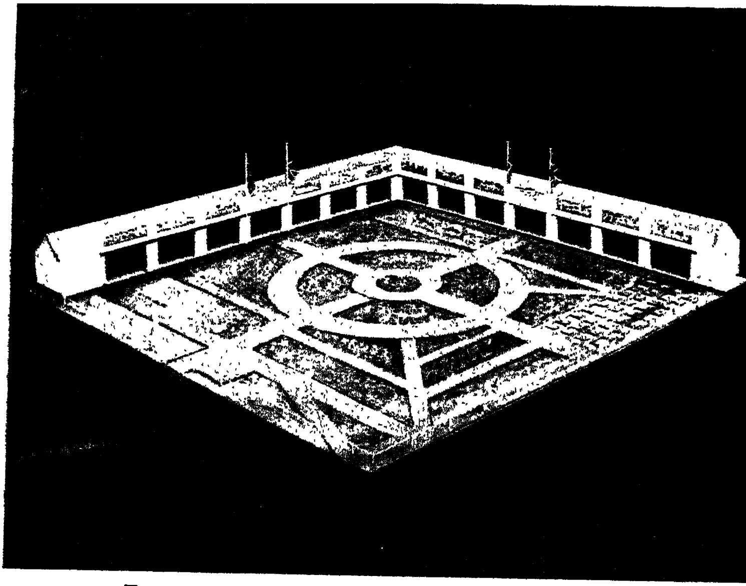

FIG. 1.—Model of the Exhibit, showing general lay-out.

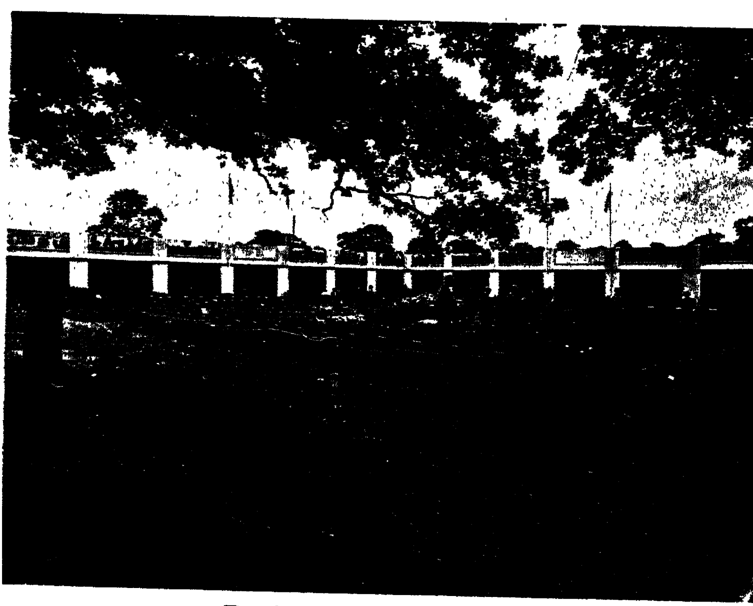

FIG. 2.—General View of Exhibit.

FIG. 3.—Demonstration plots showing the effect of soil acidity on crop growth. Right to left—Sugar Beet, Barley and Potatoes. Very acid plots in foreground.

since when the pH rises above about 6.4 the manganese in the soil becomes unavailable ; if the pH remains at about 5.8—6.0, growth of oats is satisfactory.

Weed Control.—The control of weeds in a cereal crop by means of chemical sprays was demonstrated in a long rectangular plot. Weed seeds had been sown in a crop of oats, and at the appropriate time certain portions had been sprayed with copper sulphate, others with sulphuric acid, whilst control portions had been left unsprayed. The effect of the sprays upon both the weeds and the cereal was readily seen.

Cereal crops.—Two beds were devoted to a demonstration of cereal varieties. One contained a few drills each of various oats, such as Bountiful, Resistance, Victory, Grey Winter, Eagle, Star, Golden Rain and Marvellous ; of various barleys, including Plumage Archer and Spratt Archer, and of typical winter wheats including Juliana, Wilhelmina, Steel and Squarehead's Master. In the other bed monthly sowings of Little Joss wheat had been made from October until April : alongside were drills of A1 and Red Marvel sown in March, and April Bearded sown in April. At the time of the Show the Little Joss sown later than February gave no sign of forming ears. It is, perhaps, unfortunate that this particular demonstration was put in, since climatic conditions this season have permitted Little Joss to ripen even when sown as late as the beginning of April ; nevertheless, the general principle that this variety should not be sown later than the end of February is worth stressing.

Other crops.—Space was devoted to certain varieties of early potatoes, particularly the very early Doon Star, and there was also a plot showing the influence of size of seed, sprouting seed, cutting of setts, and method of application of artificial fertilizer on potatoes. Although considerable differences made themselves manifest during the preparation of this section, the differential effects were rather masked during the week of the Show. On the other hand, the plot showing the advantages of using potato " seed " free from virus diseases was very convincing.

The importance of singling sugar beet early was pointed out in a series of parallel plots, and alongside were half-a-dozen varieties of kale to illustrate the choice open to the farmer wishing to find a substitute for swedes.

Pests and Diseases.—The danger of " Take-all " disease arising from the too frequent sowing of a wheat crop was illustrated by a diseased crop growing on soil taken from a field which had had four crops in succession.

The use of Paris Green and bran as a broadcast poison against leather-jackets, the advantage of early sowing over late sowing in diminishing the attack of frit-fly on oats, and the remarkable efficiency of metaldehyde and bran as a slug destroyer

were shown on another section. These displays were much more convincing than the usual museum stuff, not only because the plants were actually growing but because in some cases the soil had been actually taken from farms where the troubles had been discovered.

Grasses and Grassland.—Some interesting features concerning the improvement of grassland by fertilizers, mechanical treatment and so on were to be seen in a section occupied by huge turves removed from experimental centres. These were not the usual one-foot-square turves which are so unconvincing in boxes, but large carpets. One was a section through a path, showing how wild white clover is stimulated by treading and the absence of shade; another illustrated the cultivation effect due to rooting by pigs. Some of the turves were from areas that had been manured with pig manure only, cow manure only, and poultry manure only. It was interesting to observe the complete disappearance of white clover from the poultry manured area, and the tremendous development of cocksfoot.

Close to this section was a botanical garden divided into three parts, dealing respectively with leguminous forage plants, grasses and poisonous plants. A row of each species of the first two, and individual plants of the last, were to be seen growing, and practically every specimen was in flower at the time of the Show, enabling easy comparison to be made.

The presence at the Show of many delegates to the International Grassland Congress led to numerous interesting discussions at this section of the educational exhibit.

The labelling of all the outside exhibits was done on a uniform plan, in clear hand-painted type on a cream background, varnished over. This, again, was the work of the art schools of Staffordshire. The name boards were oblong, supported on iron stakes bent backwards at the top to permit of easy reading.

Inside Exhibits.

In the centre of one side of the pavilion was a series of posters explaining the provision for agricultural education and research in the West Midland Province; below this was a model, to scale, of the whole exhibition, made by the Stoke-on-Trent School of Art. By consulting this model the visitor could quickly find out the location of any particular section in which he happened to be interested.

At one end of the building was the Economics exhibit. Here was displayed a model, made by the Oakengates Fellowship, Shropshire Association of Mutual Service Clubs, of a Staffordshire farm, and two large diagrams illustrating, in the first place, the make-up of a "typical" Staffordshire holding as revealed by the agricultural returns, and, secondly, what the typical

Fig. 4.—Poultry Husbandry Section.

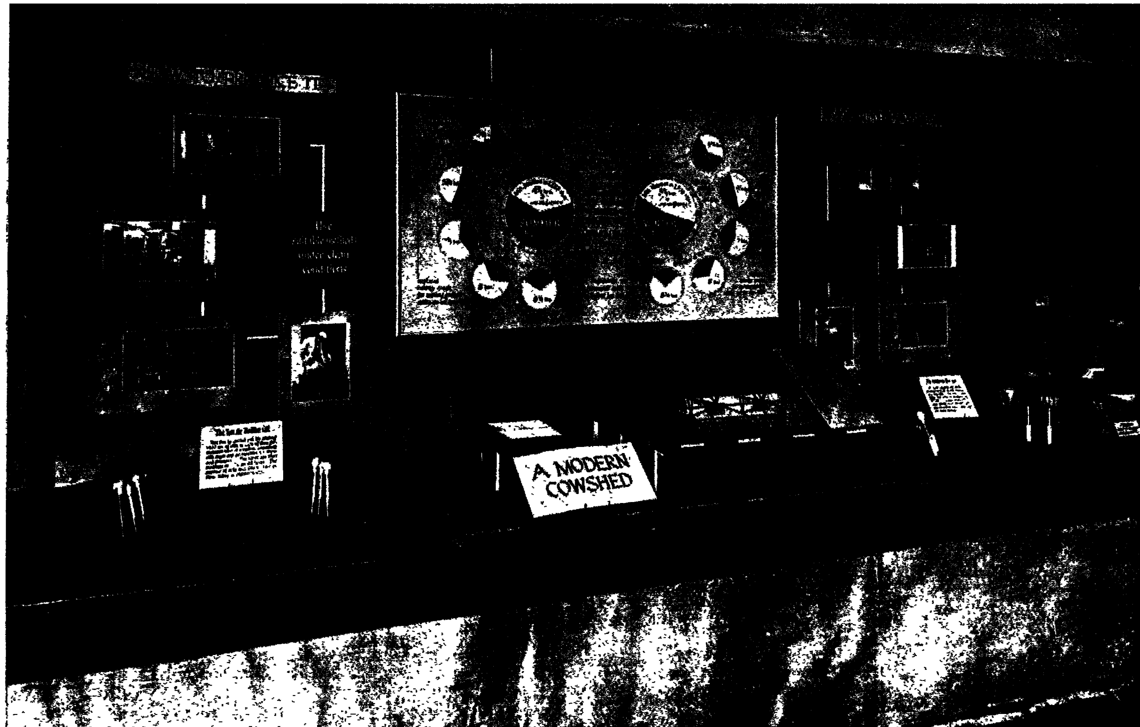

FIG. 5.—"Clean Milk" Exhibit.

farmer bought and sold last year. This exhibit had the merits of simplicity and directness, and the few figures quoted invited further investigation from visitors.

Next came a display of monoliths illustrating the structure of the chief types of soils found in the West Midlands, together with profiles explaining the chief manurial needs of sandy, clay and loamy soils. These were amplified by pot experiments. The chief lessons to be learned from this section were that the light soils show an all-round deficiency in plant nutrients, and that drainage problems on the heavy soils are extremely important.

An observation hive, with bees working within, formed the chief attraction on the Bee Keeping stand. Also illustrated were ancient and modern methods of apiculture, and methods of putting up honey for sale.

Horticultural subjects occupied considerable space. Salad plants were demonstrated in tremendous variety, and there was a special section dealing with the profitable cultivation of asparagus. By means of diagrams and growing specimens it was pointed out that the male asparagus plant is very much more profitable to grow than the female, or berry-bearing plant. A large and well spaced exhibit was concerned with the propagation of plants, both in nature and by cultivation. Cuttings, layering, grafting and so on were explained by actual living examples, and hints were also given by means of models on the best ways of raising seedlings and cuttings.

The work of the plant pathologist was explained by an exhibit dealing with the diseases of the tomato. This crop is of increasing importance in the West Midlands, where a considerable amount of glass has been erected during the last few years. Fungus, virus and non-parasitic diseases were illustrated by pot plants, clearly labelled, and by large posters containing a minimum of lettering. The cause and control of the particular complaints were given clearly and concisely.

The work of the economic entomologist was similarly explained on the next stand, but in this case the apple was chosen as an example. This exhibit was mainly photographic, on account of the well-known difficulties of staging live insects in a convincing and convenient manner. The use of sprays, grease banding, and other control measures were indicated.

Milk and dairy products came in for a good deal of attention. In the centre of the exhibit was a well arranged display of dairy products, mainly different varieties of cheese, which by the judicious use of ice were constrained to maintain their attractive freshness throughout the period of the Show. Visitors must have been intrigued to learn that there are so many different sorts of cheese.

Next to this was a demonstration of the faults that may occur in dairy products, and an explanation of the desirability of using a reliable starter in cheese making. On the other side, clean milk came in for attention. A modern cowshed was shown in model form, and photographs pointed out the correct and incorrect methods of handling milk. Modern methods of testing milk for bacteria were also explained. The methylene-blue test was compared with the plate test, and the conclusion reached was that, on the data so far available, there seemed a pretty fair agreement between the two methods.

Rations for various forms of livestock could be obtained from an ingenious piece of apparatus which lighted up a panel as soon as a model animal was inserted in a slot at the base of the machine. If a model sheep were inserted, rations for a sheep became illuminated; if a cow were inserted, the appropriate details appeared, and so on. This was a very simple and much appreciated device, but truth compels one to state that the panel to illustrate breeding for milk was fought shy of by most of the demonstrators. Its apparent simplicity was most deceptive, and one or two good stories are told about it. Farriery was dealt with by an exhibit of various shoes, and models showing the formation of the horse's foot.

The veterinary section was in two parts. One part dealt with animal diseases and the other with poultry diseases. Tuberculosis was dealt with by models and posters. The railing-off of ponds, double fencing of boundary hedges, removal of poultry, and other precautions were explained. A bad lay-out and a good lay-out for a dairy farm were shown by models. Liver rot in sheep was another disease dealt with in this section. A large model of a water snail, the intermediate host of the liver fluke, was the central figure, and the various stages passed through by the parasite were explained by large-scale diagrams. Methods of control by carbon tetrachloride capsules administered to the sheep, and by copper sulphate sterilization of ditches and water-courses, were explained. The importance of suitable drainage and sanitary precautions in the treatment of Johne's disease were also stressed by means of models.

"Gapes" in poultry was the subject of a further exhibit in the veterinary and poultry sections. The life history of the parasitic worm was explained by drawings and photographs, and precautionary and remedial measures were outlined in a similar way. A device for extracting the worms from the wind-pipe of birds was shown.

In the poultry section stress was laid upon the necessity for keeping only the good layers. The difference in egg production between a good and a bad layer was admirably shown by a series of egg racks, one for each month of the year. In each double

rack was placed the number of eggs laid respectively by a good hen and a poor hen, and the contrast between the two was very convincing. Adjacent was a large poster pointing out that the good layer gave a profit over food costs of 22s., and the poor layer a profit of only 8s. 2d. Typical good and bad layers of the Light Sussex breed were exhibited as stuffed specimens; models of good poultry houses were also on show, and there were references to the National Poultry Institute Research Scheme and to Laying Trials. Another part of this exhibit was concerned with the raising of an auto-sexlinking barred Brown Leghorn. Skins were exhibited to show the necessary crosses up to the fifth year, and how the sexes may be distinguished soon after hatching.

Breeding experiments were the subject of the rabbit section. The idea was to point out how new varieties may be obtained by breeding on mendelian lines, the cross illustrated being that between a Lilac and a Castorrex, taken to the second generation. Four hereditary factors were involved, three for colour and one for fur length, with the result that in the second generation no less than 16 different fur characters segregated out. These were illustrated by specially prepared skins; the contrast between some of these and the grey Agouti, or normal wild grey, of the first generation was very striking, and led to much discussion.

The Ministry of Agriculture had a small section at one end of the pavilion displaying their publications, which were also on sale.

From experience and observation at several Royal Shows there seems no doubt that an open stand combined with growing crops is a better means of attracting visitors than a totally closed exhibition tent. On the other hand, the amount of labour involved in setting up an exhibit such as that here described is very considerable, and is a severe drain upon the time and energy of the educational and research workers concerned. Whether or not other areas will think it worth while to finance such an elaborate exhibit for the five short days of the Show remains to be seen; meanwhile attention is drawn to some suggestions on this subject made by Mr. H. B. Tilley in an article which appeared in the October issue of *Agricultural Progress*, the Journal of the Agricultural Education Association.

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THE FORESTRY EXHIBITION AT THE WOLVERHAMPTON SHOW.

THE Forestry Stewards (Lord Hastings and Mr. A. D. C. Le Sueur) are to be warmly congratulated for having attracted to the Royal Show at Wolverhampton a large number of interesting exhibits which were well staged both inside and outside the tent. As in previous years, the indoor competitive classes were very limited, and on this occasion there was only one exhibit in each class; so the real interest was centred on the non-competitive classes, which provided scope for any exhibitor to display his special talents. Medals were awarded, at the discretion of the Judge and Stewards, in any of these classes, and they were just as attractive to exhibitors as the competitive classes. It is open to question whether it is worth while to continue the indoor competitive classes in future years.

One of the most interesting features was the collection of exhibits prepared by firms who are especially equipped to advise owners about forestry or to take over the management of their woods. Woodland management is now a matter for specialists, and as small estates are taking an increasing interest in forestry, the demand on such firms for the specialized knowledge and facilities which they can provide is likely to grow; and it is a legitimate use of Forestry Sections at Agricultural Shows to make known to landowners that such firms are willing and able to help them. It is probable that the competition between the firms will in time induce them to prepare exhibits which demonstrate more convincingly than those at Wolverhampton the services which they can render. But Messrs. Mould & Bloomer's display of models demonstrating methods of treating derelict woodlands and planting for amenity were of great interest, as were their exhibits of tools and of tree surgery. Messrs. Fisher, Sanders & Company entered a rather academic working plan, photographs of hedge-laying and a model of a ramp to let rabbits escape from plantations. Each firm received a bronze medal.

Captain G. C. Wolryche-Whitmore was awarded a silver medal and the special silver-gilt medal for the best general collection of exhibits. Of these the most interesting was a collection of mechanical tools and gadgets which were displayed outside the tent in an area very carefully prepared with nursery lines, weed patches, hedges, etc., on which they could be demonstrated. These tools included a Simar Rototiller, a Benjamin Reid Blowlamp for killing weeds and weed seeds, transplanting boards, a Motor Scythe by Allen of Cowley for cutting rubbish between lines in young plantations, a home-made Earth Anchor

and Log Lifter, and a German Bark Peeler. There were also a portable Creosoting Tank and a motor unit which worked a Hedge Clipper, a Paint Sprayer and Sander. Whether all these instruments are essential to economic estate management is open to question, but anyone with a flair for machinery who tries them out and helps to perfect them is undoubtedly doing very useful work, and by getting them together and displaying them to others Captain Wolryche-Whitmore has earned our grateful thanks. He also erected on the show ground a Slob Hut roofed in the Norwegian fashion with turves; the turves should be laid on a waterproof skin of thin creosoted boards. Within the tent the same exhibitor showed transplants in pots—many of them rather large for forest work—specimens of insect damage and wheelwright material.

A silver medal was awarded to Lord Barnard for a very remarkable exhibit prepared by Mr. Childs of the Shropshire Estate Office at Uppington. This exhibit contained door and window frames and a large number of other building parts so constructed as to utilize as much wood from the estate as possible. That it was the result of very long experience was proved by a book of photographs of numerous estate cottages as they appeared before and after reconstruction by the estate staff. This exhibit was a very fine demonstration of practical and useful craftsmanship.

The City of Birmingham Parks Committee also received a silver medal for a collection of cones, specimens of insect, fungus and other damage to tree crops, and pieces of timber showing the effect of pruning, injuries, etc. This exhibit, which was prepared by Mr. R. H. Munro, was not only very instructional but was beautifully set up.

The silver medal awarded to the Land Agents' Society was well earned by a series of products from estate yards and carpenters' shops, including gates, troughs, seats, wheelbarrows, etc., and an oak refectory table.

The Timber Development Association Limited, which received a silver medal, showed ancient elm piles from London and Waterloo Bridges, and chestnut from the Abbot's Barn at Glastonbury, models, photographs, and informative descriptions of wooden houses, etc., and specimens of wood. The object of the Association is to encourage the use of wood, and the evidence they produced from the past lent support to their well-founded claims for timber buildings to-day.

Bronze medals were awarded to Messrs. R. A. Lister & Co., Ltd., for a display of turnery, including shoehorns, wooden jugs and bowls and a small churn; and to Mr. W. C. Kiplinger, of Michigan, for a safety saddle and other appliances to reduce risk in tree lopping and pruning.

There were only three indoor competitive classes and they were very poorly patronized. Viscount and Viscountess Swinton received a silver medal for an exhibit of boards of oak, elm, sweet chestnut, sycamore and beech. The beech was unusual, and had a beautiful wavy grain; the sycamore was also very good. The same exhibitors also entered in Class II for coniferous timbers, but their collection was incomplete and, though the larch was good, the Douglas fir was very knotty and the Scots pine had blue stain. Among the non-competitive exhibits they showed an interesting collection of rarer woods. The only entry in the other classes—which were confined to trade nurseries—was the English Forestry Association Limited, which received a silver medal for a rather miscellaneous collection of nursery plants in pots. The collection contained a black walnut seedling of the current year, which was 8 inches high. It should be worth while for many more trade nurseries to compete in this class.

Some of the most valuable exhibits were not entered for awards. Among them was a large collection, erected by Mr. Maitland for the Forestry Commission, which illustrated his recent Bulletin on Turnery Wood. Specimens had been collected from a very large number of manufacturers and included a remarkably wide range of uses, from large parts down to the smallest electrical fittings. There was also a demonstration of the Dutch Elm Disease, which had been prepared by Mr. Day at Oxford. The whole was an outstanding contribution.

The Chartered Surveyors' Institution were represented by a collection of fungi causing diseases, including *Fomes annosus*, *Polyporus sulphureus* and larch canker, and some planks, among which the sweet chestnut and alder were remarkably fine. Mr. Le Sueur also showed a series of photographs, maps and plans from the Royal Agricultural College, Cirencester.

A combined exhibit was prepared by Mr. R. C. B. Gardner for the Royal English Forestry Society, the British Wood Preserving Association, and the Home Grown Timber Marketing Association. This included his very valuable collection of new or little-known forest tools, a fine collection of photographs of forest interest, and methods of preventing insect and fungus attacks.

The section as a whole was one of the best held for many years and reflected the renewed interest which landowners are taking in forestry.

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Devon.

REPORT ON GATES, TREE GUARDS AND FENCING AND GATE MAKING COMPETITION, WOLVERHAMPTON SHOW, 1937.

THE classes for field gates were fairly well filled, with the exception of Class V (one entry only). It is a pity that the cleaving or rending of oak for making gates is not now so common as it used to be, for a good cleft oak gate will at least cost no more and will last quite as long as a sawn gate. In different parts of the country the type of gate made varies and it would be a good thing if at future shows the schedules could have classes for both planed gates and others made direct from the saw cuts; the latter are more economical and quite as strong. There was little new in the methods of catches and hangings; many of the gates had an old-fashioned oak or swing latch which, with the spring latch, is the most serviceable fastener if kept in working order.

The awards made were as follows :—

For the best oak field gate for farm use, the first prize was awarded to the Chatsworth Estates Co. for an admirably made gate of good material, with perfect joints. The hanging posts were 8 inches by 8 inches, the falling post 7 inches by 7 inches. The gate was fitted with a spring latch and was well hung.

Second prize awarded to Captain G. C. Wolryche-Whitmore, Bridgnorth, for a well-made gate fitted with the oak fish-latch and hung on the same size of posts as the winner.

No. 5 in the class was a well-made gate of good material, but the posts were too small to carry the weight.

It would be a good thing if all gates could be specified to be of one length, say 9 feet 6 inches or 10 feet; with the advent of new machinery anything less is not wide enough for general purposes.

Class 4 was for a field gate of any other home-grown wood or combination of home-grown woods. The majority of gates shown in this class were made of larch bars with oak heads and heels. The first prize was awarded to Mr. Benyon, Englefield, Berks., for a well-made larch gate; it was the best jointed in the whole entry. The posts were also made of good, sound larch; the bars were fitted with galvanized bolts, which are now being used more frequently in gate making.

The second prize was won by the Chatsworth Estates Co. for a well-made gate comprised of larch bars with oak head and heels and fitted with an adjustable top hinge.

No. 10 was a well-jointed gate of good material, but was spoilt by fixing the bars with screw nails instead of bolts or clenching nails.

CLASS 6. First prize was awarded to Captain Wolryche-

Whitmore for a well-made serviceable hunt gate made of oak, with fish-latch fastenings, and pair of oak posts to match.

The second prize award went to Chatsworth Estates Co. for a well-fitted cleft oak gate, with not too heavy bars and fitted with spring latch.

CLASS 7. First prize for tree guards was awarded to the Chatsworth Estates Co. for a guard made from peeled larch thinnings. Such a guard is very efficient but expensive; but where there is not much demand for this class of thinnings it is a very suitable type for the protection of standard trees.

CLASS 8—Field fencing of home-grown wood. The first prize was awarded to Captain Wolryche-Whitmore for a strong, serviceable fence, with posts of creosoted oak, and rails of split larch sawn down the middle, about 4½ inches by 2½ inches—a capital stock fence.

CLASS 9—Park or ornamental fencing. The first prize in this class was also awarded to the above exhibitor for an oak pale fence with rails 4 inches by 2 inches and pales 4 inches by 1 inch—a most suitable fence for park or garden.

A GATE MAKING COMPETITION was held during the Show and was open to all those employed on *bona-fide* private estates, working in pairs. This Competition was an attraction to many visitors. Sawn oak material was supplied by the Society, and the men drew lots for the different sets. A pattern gate (Shropshire) was supplied to be worked to, and the plane was only to be used for fitting in bars. Six couples entered and, with one exception, did excellent work; the men appeared very keen and quick at their work. The first prize of £5 was awarded to William Evans and Stephen Jones, of the Apley Estate Co., Bridgnorth, who made an excellent job of their task, measurements, joints and fittings being perfect, and their time—mortising, fitting and finishing gate—being 1 hour 59 minutes. Another pair of men from the same Estate took the same time, but they were unfortunate in damaging one of the uprights; also the top bar was not too well jointed. They were awarded the third prize, £2. Their names were E. Burton and S. Cole.

The second prizewinners (£3) were Richard Childs and Thomas Pritchard from Lord Barnard's Raby (Shropshire) Estate, who completed their gate in 1 hour 45 minutes. They lost points by not properly clenching the nails in fixing bars. Two men employed on the Estate from Trinity College, Cambridge, were unfortunate in making a mistake when setting out their gate and had to give up after one-and-a-half hours' work.

ALEXANDER SLATER.

Oakhurst,
Newland,
Malvern.

REPORT ON THE WOODLANDS, PLANTATIONS AND ESTATE NURSERIES COMPETITION, 1937.

THE Woodlands, Plantations and Estate Nurseries Competition for 1937 was restricted to the counties of Leicestershire, Warwickshire, Rutland and Northamptonshire. It is very much to be regretted that there were so few entries in the competition. Those woodlands entered were, however, on the whole of a good standard, especially considering that they were not growing under really first-class conditions of soil and rainfall. We found very great interest being taken in the plantations on the estates we visited.

As a whole the competing woodlands were suffering from several faults in cultivation which are only too apparent throughout England. The crops of the coppice areas, and of the hardwood areas generally, were very much understocked: the middle-aged plantations were sadly lacking in systematic attention to thinning, many having been left too long underthinned. The consequence is that little financial return can be coming in from these planations, though (again as is usual) the agents seemed to be getting quite full prices for the mature oak and ash which was being sold. On the other hand, we found young plantations well laid out and established, and areas in the thicket and early pole stages well fenced and looking full of promise. One point was of very considerable interest: on the Boughton and Stanton Ironworks estates all the plantations had been established without any rabbit netting. The results were very good, with the exception of one area where the rabbits had been allowed to become too numerous in the thicket stage; in this case considerable damage was being done. We should like to make one recommendation for the future, namely, that it should be laid down that a reasonable number of paths be cut through the plantations that are in the thicket stage, to enable the judges to examine them properly: in several instances this year there was not a single path opened up for the judges' use.

No entries were received in the following classes:—

I (*a*). Plantations 10–25 years old where hardwoods are intended for the final crop.

V. Coppice or coppice with standards.

Two entries were made in Class IV for crops consisting of the rarer conifers, both by the Bradgate Woods, Ltd. Unfortunately they were wrongly entered in this class and they were too young to make possible their transference into another class. We were

taken round them by the agent (Mr. J. Bruce Galloway) and the forester (Mr. Pringle). They had been established on areas that had been cleared by some timber merchant and left derelict, with a mass of tree tops grown over by bramble. Initial clearing costs on such land are very heavy, but they had been got down here in the end to the reasonable figure of £6 per acre. Some very useful young plantations had been established, the main crop being a mixture of larch and Scots pine, with a few oak widely spaced. The Scots have in places suffered badly from attacks of *Evetria* (*Tortrix*) *buoliana ;* otherwise the trees were all healthy, the larch in particular promising well. It is hoped that the natural ash and sycamore seedlings coming up over much of these areas will be allowed to fight it out with the planted crop, in which case a full final crop of hardwoods mixed with big larch should be the result. These two plantations were in our opinion economically and judiciously established, and should make interesting areas for competition the next time the Woodlands Competition takes place in this part of England.

CLASS I (*b*). *For plantations over* 25 *years old where hardwoods are intended for the final crop.* There was one entry only. The silver medal was awarded to Boughton Estates, Ltd., Kettering, for 15 acres of oak, ash and larch planted in 1900 and partly under-planted with beech in 1910-12. The wood is on heavy, low-lying soil. The larch has done only moderately well, and has been largely cut out. The main crop is now ash, looking very healthy and growing well. Serious damage by the grey squirrel has commenced here on the beech.

CLASS II (*a*). *For plantations between* 10 *and* 20 *years old, where the final crop is intended to be conifers.* There were two entries from the Ragley Estate (Cold Comfort No. I and Deerings Hill) ; also one from the Stanton Ironworks Co., Ltd. The silver medal was awarded to the *Deerings Hill Plantation,* established in 1925, with pure European larch as the main crop with a few Scots pine and spruce on the outside. The larch are healthy and growing well, making an even plant at 5 feet by 5 feet. There are a number of self-sown sycamore coming up among them ; the best of these should be conserved, and should then materially help the main crop of larch. The Cold Comfort Plantation is on heavier soil and was also established in 1925, with the main crop European larch. The larch are not so straight, nor are they growing so fast as on Deerings Hill. Rabbit damage is more in evidence, and there are patches where seedling birch is being allowed to smother out the planted trees.

The bronze medal was awarded to the Stanton plantation, which was established in 1924 with mixed conifers. The iron-

stone here has an over-burden of some 5 to 10 feet of soil, which is flung on one side by large mechanical diggers, so as to expose the ironstone. This is quarried and a further strip of over-burden is then cast back, the ironstone quarried, and so the work proceeds. The result is an area of mixed stone and soil, in ridges, hollows, and hummocks, which would cost £100 per acre to level, and so is useless for any form of agriculture. Trees do very well on it in places, and it is to this use that the Stanton Ironworks Co. have put their derelict land. The plantation is on a long strip of ground, and it is interesting to note that it was successfully established without the protection of any rabbit netting. It is a great pity that rabbits have been allowed to multiply here in the last two or three years; they are doing considerable damage to the trees, and also to an excellent quick hedge which was planted alongside them. Many *Populus alba* have been dotted about this planation, and give it a very pleasing appearance. The larch are doing well, so are the Scots pine, but the Sitka spruce are very spindly and rather suppressed.

CLASS II (*b*) (the same conditions as for II (*a*), except that the plantations have to be over 20 years old). There were three entries—Newman's Hill (Ragley Estate), planted 1897 with European larch and Corsican pine; Coronation Wood (Noseley Estates Co.), planted 1910 with Japanese and European larch, together with some Douglas fir and Scots pine; and the Deer Close Planation (Bulwick Park Estate), planted with pure European larch in 1907. The silver medal was awarded to Mrs. E. M. Conant's *Deer Close Plantation*. It is an even crop, growing well. Though thinning operations have been left rather too long, these are now being taken in hand and are being well carried out. The bronze medal went to *Coronation Wood*. Here again the whole plantation has not been thinned sufficiently early, but has as yet not suffered very badly in consequence. The European larch are outgrowing the Japanese in this plantation.

CLASS III (*a*). *For plantations under 20 years, old where a mixed final crop of conifers and hardwoods is intended.* There was only one entry; this came from the Ragley Estate, and consisted of an 11-year-old plantation on Three Oaks Hill of Japanese larch and ash. The larch are growing vigorously, but are showing a marked tendency towards producing crooked timber, as is so often the case; the ash are already largely suppressed, and have in places been badly damaged by rabbits. No award was given in this class.

CLASS III (*b*) (the same conditions as for III (*a*), only the plantations have to be over 20 years old). There were three

entries, two from the Boughton Estates, Ltd. (Ironstone E, Geddington Grange, and Ironstone F, Glebe Pit), and one entry from the Noseley Estate (Rollesdon Dingle Wood). This latter plantation is really pure larch in one part and pure ash in the remainder, but as neither area was big enough to be entered by itself, the judges allowed the entry to stand and awarded it the bronze medal. The ash are particularly healthy, but here again the trees require thinning quite heavily if the best financial results are to be obtained.

The silver medal was awarded to the *Ironstone F, Glebe Pit, Plantation*. This is on old worked ironstone soil, as described under the Stanton Ironworks entry (Class II (*a*)). All the plantations on this estate have been established without the help of any rabbit netting. This plantation was established during 1910–12 with European larch, oak, ash, hornbeam, sycamore and poplar. It is being well looked after and is being correctly thinned. The larch, sycamore and ash are all doing well, and should make a first-class final crop, as well as yielding valuable thinnings over a long period. In parts of this plantation there are some interesting plots of pine, Douglas, Thuja, alder, etc.

CLASS VII. In this class, for the best-managed woodlands on estates of over 1,000 acres, there were only two entries—the Ragley Estate of 1,096 acres of woodlands and the Apethorpe Estate of 257 acres of woodlands. The woodlands have had a lot of attention paid to them, and in some cases promising results are being obtained. A considerable portion of these woods must be classed as amenity, and they are well laid out for shooting.

The estate nurseries and sawmills on these two estates were not up to the standards seen on many estates in England and we are of the opinion that the system of clear felling and replanting, as practised on the Ragley Estate, is not an ideal one. One award was given in this class, and it went to the Ragley Estate. The young plantations on this estate were growing well, and seemed to have been carefully and economically established. In the case of some of the older plantations, however, lack of systematic thinning was much in evidence. The older woods contain a fair quantity of valuable oak and ash, which is being cut in considerable quantities, and there must be a shortage of middle-aged hardwoods to take their place if the present system of clear felling continues.

The gold medal, offered by the Royal English Forestry Society, for the best plantation in the woodlands visited, was awarded to the hardwood portion (some 60 acres) of the *Ladies Hill Plantation* on the Ragley Estate. This consists largely of fine mature oak, with ash poles of all ages interspersed between them. The

crop is a good one, and it is to be hoped that a well-thought-out system of selective felling will here be carried out. If this is done, if natural regeneration is encouraged, and the replanting which is necessary in places is carried out, a really valuable crop of mature ash should take the place of the now dominant mature oak.

The summary of awards is as follows :—

Estate.	*Medals.*	*Classes.*
Boughton	Silver	I (*b*) and III (*b*)
Mrs. E. M. Conant	Silver	II (*b*).
Noseley	Bronze	II (*b*). & III (*b*).
Ragley	Silver gilt	VII & R.E.F.S. Gold Medal.
	Silver	II (*a*).
Stanton Ironworks Co.	Bronze	II (*a*).

C. P. ACKERS.
P. S. BARNIE.

REPORT OF THE COUNCIL TO THE ANNUAL GENERAL MEETING OF GOVERNORS AND MEMBERS OF THE SOCIETY,

HELD AT

16, BEDFORD SQUARE, LONDON, W.C.,

On WEDNESDAY, December 8, 1937, *at* 12 *noon.*

Royal Patronage.

1. At their first meeting of the present year, the Council received an intimation that His Majesty King George VI had been graciously pleased to bestow upon the Society his Royal Patronage. The Society look back with gratitude upon many marks of favour conferred by the Royal House, not the least of which was His Majesty's Presidency of the Society in 1922. They have also the happiest recollections of the presence of Their Majesties The King and Queen at the Annual Show of the Society on more than one occasion.

Membership.

2. The list of Governors and Members has undergone the following changes since the Annual General Meeting on December 9th, 1936: 13 new Governors (including 7 transferred from the list of Members under Bye-law 9) and 391 new Members have joined the Society, and 5 Members have been reinstated under Bye-law 14; whilst the deaths of 5 Life Governors, 4 Governors, 54 Life Members, 176 Members and 1 Honorary Member have been reported. 2 Life Governors, 5 Life Members and 12 Members have been struck off the books under Bye-law 12, owing to absence of addresses; 133 Members under Bye-law 13, for arrears of subscription; 7 Governors and 204 Annual Members have resigned.

3. Since the last Report was issued the Council have lost by death two of their number—Mr. E. Guy Fenwick and Mr. Frank Webb.

Mr. Fenwick, who had represented the Division of Rutland since 1921, was keenly interested in the breeding of hunters and Percheron horses and had been a judge at the Society's Show. By his passing, many Members lost a dear friend.

Mr. Frank Webb's association with agriculture had been a long and creditable one. With his wide knowledge and experience of live stock, his services as a Member of the Stock Prizes Committee of the Council were of immense value. His abilities as a judge of cattle, sheep and pigs were of a high order, and his services in this capacity were much in request at the Royal and other Shows. Elected a Member in 1905, Mr. Webb had been a Member of the Council since 1926 as the representative of Bedfordshire.

4. In March occurred the death of that well-known agriculturist and breeder of Shorthorns, Mr. Richard Stratton, of Newport, Mon., at the age of 94. He had been a life Member for 70 years and served on the Council from 1875 to 1907, during which period he took a very active part in its deliberations.

5. Another loss has been sustained by the passing of Lord Ernle, who from 1916 to 1919 was President of the Board of Agriculture. Two years ago the Council conferred upon him the Gold Medal and Honorary Membership of the Society in recognition of his distinguished services to agriculture.

6. The death of Dr. Voelcker on the 6th November will be deplored by all who were associated with him in his work for agriculture at home and abroad. His connection with the Society as Consulting Chemist extended over a period of 52 years.

7. Amongst other Governors and Members whose loss by death the Society has also to deplore are Earl Ferrers, the Earl of Londesborough, Lord Cawley, Lord de Saumarez, Lord Gifford, Lord Kylsant, G.C.M.G., Lord Wyfold, Colonel the Right Hon. H. H. Spender Clay, Sir P. H. B. Grey Egerton, Bt., Sir Harry M. Mallaby-Deeley, Bt., Fanny Lady Leon, Colonel Alfred Dyke Acland, C.B.E., Mr. Joseph Bamford, Mr. G. Titus Barham, Mr. F. S. Courtney, Mrs. Leopold de Rothschild, Mr. H. M. Fildes, Lt.-Col. E. W. Griffith, D.S.O., Mr. Thomas Hacking, Mr. A. R. Midwood, Colonel E. H. Nicholson, Mr. J. C. Straker and Mrs. Lewis D. Wigan.

Numbers on Register.

8. These and other changes bring the total number of Governors and Members on the Register to 8,823, divided as follows :—

136 Life Governors ;
197 Annual Governors ;
1,560 Life Members ;
6,914 Annual Members ;
16 Honorary Members.

8,823 Total number of Governors and Members, as against a total of 9,024 on the Register at the time of the last Annual Report.

Membership Committee.

9. Reference was made in last year's Report to some suggestions which had been adopted by the Council, concerning the privileges of Governors and Members. The Committee on Membership and Publicity have since held several meetings and gone very thoroughly into these matters. The Committee were of the opinion that advertisement as such, which would be very costly, would not secure many new subscribers. Neither did they see their way to recommend incurring the expense of paid canvassers.

10. All will agree, however, that something should be done to stop the steady decline in membership, which has decreased from the peak figure of 13,573 in 1925 to 8,823. The Council feel that a strenuous attempt should be made to bring the membership up to something like its old figure by 1939—the Centenary Year. This cannot be done without a determined effort by members of the Society generally.

11. Those best able to make an appeal are the members of the Council, and this has been done on more than one occasion by individual members with good results. It is suggested, therefore, that the representatives on the Council should form committees in their respective counties of those who are keen on the work of the Royal Agricultural Society, and that these local committees should approach non-subscribers in their areas with a view to their becoming members. These recruiting committees should be able to give valuable advice to Headquarters as to the best methods of publicity in their districts. Leaflets showing the advantages of joining the Royal Agricultural Society, and also what the Society is doing for agriculture in general, will be furnished from Bedford Square.

Presidency.

12. The Council have resolved to recommend to the Annual General Meeting the election of the Earl of Plymouth as President of the Society, to hold office until the Annual Meeting in 1938.

Changes in the Council.

13. During the year Lord Mildmay of Flete has been elected a Trustee, Lord Hastings has been elected a Vice-President, and Captain W. J. Baird has been elected to fill the vacancy in the representation of the Division of Rutland caused by the death of Mr. Fenwick.

Dates of Council Meetings.

14. The Council have fixed the following dates for their Meetings in 1938 : February 2nd, March 2nd, April 6th, May 4th, June 1st, July 6th or 7th (in Cardiff Showyard), July 27th, November 2nd, December 7th.

Accounts.

15. In compliance with the bye-laws, the Council beg formally to submit the balance-sheet with receipts and payments for the year 1936. These accounts were circulated to Governors and Members in June last, having been certified as correct by the Professional Accountants and Auditors. Copies of these accounts, and also the Statement of Receipts and Expenditure of the Show held this year at Wolverhampton, will be available for reference at the meeting on December 8th.

Contribution from Bristol.

16. The Council have to acknowledge the receipt of £188 8*s.* from the Bristol Local Committee. This sum represented the balance of the local fund and was handed over to the Society in view of the loss sustained on the Show of 1936.

Wolverhampton Show.

17. But for the breaking down of the weather after the first three days, the Show at Wolverhampton would have been visited by much larger numbers of people. The total attendance was 78,080, of whom 29,051 were present on the Thursday. It was without doubt one of the best exhibitions held by the Society for some years. Trade in live stock, as well as in implements and machinery, was reported to be of a satisfactory character. Visitors from Overseas, both from the Empire and foreign countries, were more numerous this year, and they all left with happy recollections of the "Old Country's" premier agricultural gathering.

18. Their Royal Highnesses The Duke and Duchess of Gloucester honoured the Society by visiting the Show on the Wednesday and in this connection a letter in the following terms was received by the President :—

York House,
St. James's Palace.
9th July, 1937.

Sir,—The Duke of Gloucester wishes me to write and tell you how much the Duchess and he enjoyed their visit this week to the Royal Agricultural Show at Wolverhampton. Their Royal Highnesses were much interested in all they saw on the Show Ground during their tour, which was admirably arranged.

I am desired to convey to you in particular as President and Honorary Director, to your Council, and all others concerned, Their Royal Highnesses' congratulations on what was obviously a very successful Show, together with their best thanks for the arrangements which were made for their visit.

I am, Sir,
Your obedient Servant,
(Signed) Ronald Stanyforth.

U. Roland Burke, Esq.,
President,
The Royal Agricultural Society of England.

19. The Society's thanks are due to Lord Wrottesley for the loan of a portion of his park as a site for the Showyard, and to Sir Charles A. Mander, the Mayor of Wolverhampton, and his Committee for their help and advice and more particularly in raising the local fund of over £7,000.

New Implements.

20. Three Silver Medals were awarded by the Judges of New Implements at this year's Show, viz.: to John Wilder, Ltd., for a Cutlift Elevator; to R. H. Neal & Co., Ltd., for a Drainage Trench Digger; and to Halliday Boilers, Ltd., for Sterilizing Equipment.

On the recommendation of the Judges, the Grass Drier entered by Mobile Driers, Ltd., has been deferred until next year.

Agricultural Education and Research Exhibition.

21. This section of the Show at Wolverhampton, which attracted a good deal of interested attention, was the joint effort of the Agricultural Education Committees of Staffordshire, Shropshire, Warwickshire, and Worcestershire, the Harper Adams Agricultural College, the National Institute of Poultry Husbandry, and Studley College, supervised by Dr. Charles Crowther, assisted by Mr. H. B. Tilley, of the Staffordshire Farm Institute. The Ministry of Agriculture provided the building and made themselves responsible for the staging and labelling of the exhibits. The Exhibition took the form of a rectangle of land, bordered on two sides by an open pavilion, surmounted by a frieze of art panels depicting various rural activities. These panels were designed and prepared by Staffordshire Art Schools. A report of the Exhibition will appear in the forthcoming volume of the Society's *Journal*.

Young Farmers' Judging Contest.

22. Five teams representing Australia, England, Northern Ireland, Scotland and Wales took part in this year's International Contest, which occupied the whole of the Wednesday in the Showyard at Wolverhampton. England gained the premier award by a narrow margin from Scotland, Northern Ireland came third, followed by Australia and Wales. After the judging, competitors and their trainers marched to the Royal Pavilion, where the presentation of the gold challenge cup and other awards was made by H.R.H. The Duke of Gloucester in the presence of a large crowd.

Young Farmers' Cattle.

23. In the eight classes judged on the Thursday there were 145 entries of dairy and beef cattle exhibited by members of Young Farmers' Clubs in Cheshire, Derbyshire, Lancashire, Leicestershire, Nottinghamshire, Shropshire, Staffordshire,

Warwickshire and Worcestershire. During the afternoon the President received and addressed the competitors in front of the Pavilion, and presented the prize-cards to the winners.

Woodlands, Plantations and Estate Nurseries.

24. It is a matter for regret that there were only 16 entries for the competition this year, which was restricted to the counties of Leicester, Warwick, Rutland and Northampton. The Special Silver Gilt Medal for the best managed Woodlands on an estate of not less than 1,000 acres was awarded to the Trustees of the Ragley Estate, Alcester, and this estate also won the Royal English Forestry Society's Gold Medal for the best plantation.

Next year's Competition will include North Wales.

Cardiff Show.

25. In 1938 the Society will pay a fourth visit to the City of Cardiff, and the Royal Welsh Agricultural Society are withholding their annual exhibition. Their members will be granted privileges in connection with the Royal Show.

Prize Sheet.

26. The Prize Sheet will be issued in the New Year. The Council have voted £10,000 towards the Prizes and, in addition, offers of Champions, Challenge Cups and Class Prizes have been received from the following Breed Societies :—Shire Horse Society, Clydesdale Horse Society, Suffolk Horse Society, British Percheron Horse Society, Hunters' Improvement and National Light Horse Breeding Society, National Pony Society, Arab Horse Society, Welsh Pony and Cob Society, Shetland Pony Stud Book Society, Shorthorn Society, Hereford Herd Book Society, Argentine Hereford Breeders' Association, Devon Cattle Breeders' Society, Sussex Herd Book Society, Sussex Cattle Breeders' Society of South Africa, Welsh Black Cattle Society, Longhorn Cattle Society, Aberdeen-Angus Cattle Society, English Aberdeen-Angus Cattle Association, Dun and Belted Galloway Cattle Breeders' Association, Galloway Cattle Society, Lincolnshire Red Shorthorn Association, South Devon Herd Book Society, Red Poll Cattle Society, Blue Albion Cattle Society, British Friesian Cattle Society, Ayrshire Cattle Herd Book Society, English Guernsey Cattle Society, English Jersey Cattle Society, British Kerry Cattle Society, Dexter Cattle Society, British Goat Society, Oxford Down Sheep Breeders' Association, Shropshire Sheep Breeders' Association, Southdown Sheep Society, Hampshire Down Sheep Breeders' Association, Suffolk Sheep Society, Dorset Down Sheep Breeders' Association, Dorset Horn Sheep Breeders' Association, Wiltshire Horn Sheep Society, Ryeland Flock Book Society, Kerry Hill (Wales) Flock Book Society, Clun Forest Sheep Breeders' Association, Lincoln Longwool Sheep Breeders' Association, Leicester Sheep Breeders'

Association, Society of Border Leicester Sheep Breeders, Wensleydale Longwool Sheep Breeders' Association, Kent or Romney Marsh Sheep Breeders' Association, Welsh Mountain Sheep Flock Book Society, Black Welsh Mountain Sheep Breeders' Association, National Pig Breeders' Association, Large Black Pig Society, Gloucestershire Old Spots Pig Society, Cumberland Pig Breeders' Association, Essex Pig Society, National Long White Lop-eared Pig Society, National Welsh Pig Society.

27. Special Prizes are being offered in the Poultry section by the Croad Langshan Club, Sussex Poultry Club, Buff Orpington Club, Rhode Island Red Club, Buff Plymouth Rock Club.

Closing of Entries.

28. Intending exhibitors at Cardiff are reminded that the final date for receiving entries of Live Stock is MAY 7th. Entries for Produce close on MAY 18th, and entries for Poultry, Eggs, and Butter-making Competitions on MAY 28th.

29. Applications for space in the Implement, etc., Department must be made not later than March 19th.

R.A.S.E. Centenary.

30. By gracious permission of His Majesty The King, the Show will be held in Windsor Great Park in 1939. This being the year of the Society's Centenary, it is proposed that the occasion should be celebrated in a fitting manner, and a Special Committee has already been appointed to consider the details of the proposed celebrations.

31. It has been decided to publish a History of the Society to be written by Professor J. A. Scott Watson, the Editor of the *Journal*, covering the period 1839–1939.

Show at Lincoln in 1940.

32. In response to a cordial invitation from Lincoln, the Council have decided to hold the Show of 1940 in that City, which was last visited by the Society in 1907.

Judges at Argentine Show.

33. The panel of Judges appointed for this year's Show of the Argentine Rural Society was as under :—

Shorthorn Cattle.—Capt. John MacGillivray, Calrossie, Nigg Station, Ross-shire.

Hereford Cattle.—Mr. J. C. Brookfield, The Small House, Condover, Shropshire.

Aberdeen-Angus Cattle.—Mr. Samuel K. Williams, Coolcower House, Macroom, Co. Cork, Ireland.

Tractor Tests.

34. The first series of tests under the Society's Tractor Testing Scheme was carried out during the week September 13th–20th on heavy land at East Hanney, Berks., and on light

land at Fyfield. Ten tractors were tested; these having been selected, by a Committee representing the entrants, for prior consideration out of an entry of 17 machines. The report on the tests is in preparation and will be issued in due course. Tests of the remaining seven machines will be carried out in the spring.

Awards to Farm Workers.

35. Medals and Certificates for long service have been awarded to the following farm servants during the year:—

Years' Service.	
65.	Joseph Charles Carter, Cresswell Road, Lea, Malmesbury.
64.	Richard Southam, Hodnell Cottages, Southam, Rugby.
61.	Benjamin Chidlow, The Nook, Childs Ercall, Market Drayton.
60½.	RobertWilliams, Rake Lane, Sandycroft, Chester.
58.	George Cross, Lockinge, Wantage.
56.	John Goode, Becks Lane, Stockton.
55.	William Church, Ginge, Wantage.
55.	Edward Chamberlain, Lockinge, Wantage.
55.	William Daubney, Burton, Lincoln.
55.	Leonard Swift, Forest House, Freeford, Lichfield.
53.	Charles Joseph Smith, Leopard Cottages, Shenstone, Lichfield.
52.	Elias Murkett, 7, Fairfield Road, Burnham, Bucks.
49.	Daniel Cross, Ardington, Wantage.
48.	Arthur Chainey, Betterton, Wantage.
47.	Harry Wiggins, Ardington, Wick, Wantage.
47.	Albert Chainey, Betterton, Wantage.
46.	Christopher Wm. Kettle, Brantham Street, Manningtree.
45½.	William Barratt, Maer Heath, Maer, Newcastle, Staffs.
45.	George Brown, Home Farm Cotts., Bletchley Park, Bucks.
44.	Thomas Alder, Ginge, Wantage.
43.	Jesse Smith, Hambleden, Henley-on-Thames.
42.	Andrew Elliott, Hay Close, Calthwaite, Penrith.
42.	Charles Greenstock, Dene Lane, Handley, Salisbury.
41.	Ernest Round, 16, Ebenezer Street, Coseley, Bilston.
40½.	Henry Down, Little Langford, Salisbury.
40.	John Richardson Barker, Elms Farm, Cubley, Derbyshire.
40.	Daniel Jones, Rhual Yard, Mold, Flintshire.
40.	William Lovegrove, Ginge, Wantage.

36. Claims on behalf of farm workers must be made through County Agricultural Societies on special forms which may be obtained from the Secretary of the Royal Agricultural Society of England, at 16, Bedford Square, London, W.C.1. Service qualifying for a Medal is forty years on the same or different holdings with one employer, or forty years on the same holding with different employers. Farm workers (male or female)—excluding gardeners, grooms and gamekeepers—in any part of England or Wales are eligible for the awards.

Chemical Department.

37. In number and in nature the samples sent by Members to the Society's Laboratory have been much as usual. The total number sent was 110 in 1936, and in 1937 it has been 100. Several

points of interest have arisen in the course of the examination of samples; one such was the occurrence, in a soil from the Islé of Wight, of a considerable amount of manganese; others relate to the unusual composition of certain waters, and to the action of these on metal pipes. Fertilizers and Feeding Stuffs have undergone but little change, either in regard to quality or price. Potash salts have reached a slightly higher market price, and of this account has been taken in the Tables of Compensation issued periodically by the Central Association of Agricultural Valuers.

38. Towards autumn, however, considerable activity was set on foot, consequent on the facilities announced by the Government for the more free use of Lime and Basic Slag by farmers on their own land. These constituted a decided advantage to the farmer and not a few were ready to profit by them.

39. In order to aid in this movement, the Society, through their Chemical Committee, are issuing to Members of the Society with this report detailed information and guidance with regard to the purchase of Lime and its use upon the land.

40. In the endeavour still further to secure the purity and good quality of Fertilizers and Feeding Stuffs, this Society has been very much concerned with the action taken by the Committee which it called together as representative of agricultural interests to secure some very desirable changes in the Fertilisers and Feeding Stuffs Act as at present administered. The working of the Act has clearly shown that, in certain respects, it is very unsatisfactory, and it is hoped to secure such changes in it as shall make it a really workable and useful Act.

41. In July of this year Mr. Fred Smith, who had acted ably as Chairman of the Chemical Committee, resigned the post, and he has been succeeded by Mr. B. J. Gates.

Botanical Department.

42. In the early part of 1937 unusually few enquiries reached the Botanical department. Farming conditions were abnormally difficult, for much of the land had been water-logged since the late autumn. As a consequence, most of the enquiries were concerned with the problem of catching up with the arrears of autumn sowing. The latest dates at which it was considered safe to drill wheat and winter oats were given, but, as matters turned out, the opportunities for doing so were frequently non-existent.

43. The season was further noteworthy for the prevalence of weeds both on grass and arable land. Over a great part of the country pastures carried a heavier growth of ragwort than experienced observers could recall seeing before. On arable land

the difficult conditions made the routine work of cleaning more or less impracticable, and by harvest time thousands of acres of cereals were smothered in docks. Few of the specimens sent in for identification were uncommon as weeds.

44. Fungoid diseases were not, generally speaking, as serious as usual amongst the farm crops. The market garden crops, which are gradually invading the farm, seem to have suffered considerably. The pests attacking these have accounted for the majority of the enquiries in this section.

Zoological Department.

45. The chief work of the Zoological Department has consisted in answering questions and advising as to treatment in cases of injury to crops or to farm animals by insects or arachnids. Incidents obscure in the life-history of such pests have been investigated. The crop pests enquired about have been for the most part familiar insects, and little of especial interest has arisen. Some further cases of asparagus-fly attack, noted for the first time in this country last year, have come to light, but so far it has occurred only in a fairly restricted area. Information has been furnished with regard to various external and internal parasites of farm animals, but some of the enquiries under this head would have been more properly addressed to the Veterinary Department—to which the applicant has been referred. A subsidiary part of the work has been the identification of specimens unfamiliar to the sender, though not necessarily injurious, and some of these have been of considerable interest.

Veterinary Department.

46. Members of the Society have again taken advantage of their privileges by consulting the Royal Veterinary College (through their local veterinary surgeons in many cases) concerning a variety of problems, and assistance and advice have been given whenever possible.

47. Numerous enquiries have been received for advice in general and regarding the special services at reduced fees which are available at the Royal Veterinary College for herds in which mastitis or contagious abortion are being eradicated by regular tests of all adult animals. The laboratory examination of milk samples for the diagnosis of mastitis and of blood samples for the diagnosis of abortion continues to be recommended when control and eradication on this basis appears practicable.

48. Members may be referred to last year's report for a brief summary of a few of the important facts regarding these diseases. It may be recalled that in both mastitis and contagious abortion there exist many latent cases which can only be diagnosed by

laboratory examination. These cases show no obvious symptoms, but are, nevertheless, a means of spreading disease to other animals.

49. Emphasis has also been laid on the fact that there are several kinds of mastitis due to different organisms and which must be dealt with by different measures. Other facts of importance recently ascertained by a statistical examination of the yields of large groups of infected and non-infected animals are that chronic mastitis, even though chiefly of the latent or hidden type, may cause a loss of at least 10 per cent. of the milk production of an infected cow (*i.e.*, a loss of £2–£5 per cow according to the expected yield), and that abortion infection of the udder, which is common, may also cause a significant reduction of yield though no actual abortion has occurred.

50. Attention has also been drawn to the importance of protecting the young stock from infection with the four important chronic diseases of cattle—abortion, mastitis, tuberculosis and Johne's disease. This infection occurs mainly from the older stock. Recommendations for the development of a separate herd from young animals, free from these diseases, have been made.

51. Queries relating to possible harmful effects of grazing sheep and horses on the same pastures have been received from members in the Midlands, and advice regarding stocking, parasitic infestation and the "soiling" of growing grass by sheep's urine has been given.

52. The College has carried out a considerable number of pregnancy tests on samples of mares' urine and a small number on samples of bovine urine for members, at a reduced fee. Bovine urine does not give satisfactory results by the biological tests, and we do not advise owners of cattle to send further bovine samples for this test. It is not likely that a method of testing urine from cows for pregnancy can be devised, owing to the very wide range of fluctuation in the concentration of hormone present, both in pregnant and non-pregnant cows and heifers.

53. Some samples of feeding-stuffs have been examined and opinions on their suitability for the various classes of stock have been given. It is surprising to find that there are still some farmers who do not realize that undecorticated cotton cake is an unsuitable concentrate to use for fattening lambs and for young calves.

54. Enquiries relating to suitable breeds of sheep to use on native Argentine ewe stocks, and the likelihood of success in founding flocks of pure British breeds, received from an Argentine

Agricultural Society via the R.A.S.E. Office have been dealt with at length.

55. A considerable amount of general advice relating to many different aspects of live stock farming has been given from time to time.

Animal Diseases.

56. During the first three quarters of the year the confirmed outbreaks of Sheep Scab and Swine Fever showed a decrease compared with the same period of 1936. There have been more outbreaks of Parasitic Mange, but fewer animals attacked. The record with regard to Foot and Mouth disease is not so good as it was at this time last year, and during the last few weeks a large number of outbreaks has been reported in East Anglia and the South Eastern Counties. As the disease is raging on the Continent, the Veterinary Committee have thought it advisable to ask the Ministry of Agriculture and the National Farmers' Union to draw the attention of farmers to the necessity of keeping a sharp look-out for any signs of the disease in their stock and of immediately reporting even the slightest grounds for suspecting a possible case of infection in their herds.

57. Anthrax outbreaks have increased, and on this matter the Secretary has been in communication with the Ministry of Agriculture. The Ministry state " that enquiries indicate that many outbreaks are associated with the use of fertilizers of animal origin and, to a greater degree, imported feeding-stuffs. No heavily infected cargo of either of these products, however, to which this increase could be ascribed, has been traced." Despite the recent increase in the number of outbreaks, the rate of mortality, *i.e.*, about one animal for each outbreak, is normal.

Grey Squirrels.

58. Practical and scientific opinions unite in condemning the grey squirrel as a menace and an increasing menace. It lives upon green shoots and buds, nuts and seeds, fruits, the inner bark of young trees, bulbs and roots, birds' eggs and young birds. There are, therefore, few branches of agriculture which do not suffer from its depredations and few parts of the country in which it cannot find the food it requires. Although at the present time it is not found everywhere in Great Britain, it has already colonized a very large area, and the Ministry of Agriculture is of the opinion that its extermination by those on whose lands it is harboured can be, and ought to be, effected by immediate measures of shooting and trapping.

59. After further consideration of the problem the Minister has, jointly with the Secretary of State for Scotland, made an Order under the Destructive Imported Animals Act, 1932, known as the Grey Squirrels (Prohibition of Importation and

Keeping) Order, 1937, applying the provisions of that Act to the animal in question. The Order came into force on July 31st. It is not, however, the intention of the Ministry itself to undertake measures for the destruction of grey squirrels, at any rate at present, or to make use of the power of entry on land conferred by Section 5 of the Act of 1932, since it would be preferable, in the Minister's opinion, that the pest should be brought under control by voluntary agencies. The power conferred by the Act will, therefore, remain in reserve for use in the event of voluntary efforts proving inadequate. It is accordingly trusted that the making of the Order will induce vigorous action against the animal on the part of owners or occupiers of woodlands or parks or other lands where it is prevalent.

60. In order to remove any doubt as to how the provisions of the Act may apply to an animal which, so far as is known is not imported and kept for profit, the Minister and the Secretary of State for Scotland have been guided by the view that "keeping" connotes some deliberate act done by a person for the purpose of, and having the effect of, inducing grey squirrels to remain upon his land, whether in captivity or not, but the omission by a person to take steps to destroy grey squirrels which come upon his land does not by itself constitute "keeping."

61. The Ministry hopes to enlist the aid of this Society and other organizations in an intensive campaign designed to secure the elimination of the animal by voluntary effort.

Poultry (Exposure for Sale) Order, 1937.

62. In December last a resolution was passed by the Council urging the Ministry to empower local authorities to prevent the exposure in public markets and sales of fowls in an obvious state of ill-health. Later, at a conference called by the Ministry, this course was again advocated by representatives of the Society and supported by other organizations and poultry breeders. Effect has been given by the Ministry to the Council's proposal in the Poultry (Exposure for Sale) Order which came into operation on July 1st.

New Zealand Embargo.

63. The Council regret that, in spite of their continued representations, the Government of New Zealand has, so far, not seen its way to modify its regulations and permit the importation of British pedigree live stock into the Dominion through the London Quarantine Station.

Agricultural Policy.

64. In June the Council passed a resolution in the following terms :—

"The Council of the Royal Agricultural Society of England welcomes the statement made by the Minister of Agriculture

on the Agricultural Policy of H.M. Government in the House of Commons on Thursday, May 27th, which declares that the fertility of the land should be restored and that everything possible should be done to reduce the losses caused by disease amongst domestic animals.

"Until further details are known the Council wishes to make no further comment except to assure the Minister of its earnest desire to co-operate in any way it can to assist him in bringing the policies he has announced to successful issues."

65. H.M. Government has now announced its policy and the Agriculture Act of 1937 has become law. This Act provides for increasing the fertility of the land and for contributions from the Treasury towards the purchase of lime and basic slag for this purpose. It also provides for subsidy payments for land under oats or barley as well as for land drainage carried out by drainage authorities. Part IV is an important section of the Act and deals with diseases of animals.

The Government intend to form a National Veterinary Service to be responsible for all enactments relating to Animal Diseases and to Milk and Dairies Orders. Veterinary officers employed whole time at present by Local Authorities will have the opportunity to join this National Veterinary Service. General practitioners will be employed for part-time duty in carrying out certain classes of work. Full details of the scheme have not yet been made public.

66. The Live Stock Industry Act, 1937, makes provision for the development and better organization of the live stock industry, for paying of a subsidy to producers of fat cattle, for regulating the import of live stock and meat, the holding of markets, and the slaughtering of live stock.

Research Committee.

67. Work completed includes Pig Feeding experiments undertaken for the Committee by Mr. Mansfield at the Cambridge University Farm, and a final report on them will appear in the next volume of the *Journal.* The volume will also contain an article on "The Replacement of Mangolds by wet Sugar Beet Pulp in the Rations of Fattening Bullocks," giving the final results of the series of trials conducted for the Committee at the Norfolk Agricultural Station on the disposal of sugar beet by-products.

68. Regarding work in progress, Rothamsted Experimental Station have undertaken to carry out the experiment to test the results of Cake Feeding on grassland, the scheme for which was agreed upon early this year. Experiments on the Utilization of Electric Power and the Inoculation of Legumes have been continued at Rothamsted. Research into the diseases of calves is

being carried on at the Animal Pathology Institute of the Royal Veterinary College; Grass Seeds Mixture trials are being conducted at various centres in England by Professor Stapledon, of the Welsh Plant Breeding Station; a further year's work has been done on Sheep Tick eradication by the staff of King's College Newcastle-upon-Tyne; and the Norfolk Agricultural Station have continued their investigation into the cumulative effects on a light arable soil of various methods in the disposal of Beet Tops and Straw.

69. The Research Committee's annual report to appear in the *Journal* will record the progress of these investigations during the year.

"The Farmer's Guide."

70. *The Farmer's Guide to Agricultural Research in* 1936 will appear as part of the next *Journal*. A limited number of advance prints of the *Guide* will be on sale at 2*s*. (post-free 2*s*. 3*d*.), and copies at 1*s*. will be available to the staffs and students of agricultural colleges and farm institutes *through those institutions*.

Queen Victoria Gifts.

71. For the ensuing year the Trustees of the Queen Victoria Gifts Fund made a grant of £160 to the Royal Agricultural Benevolent Institution to be allocated as six gifts of £10 each to Male Candidates, two gifts of £20 each to Married Couples, six gifts of £10 each to Female Candidates: the distribution in each class to be left until after the election to pensions by the Institution.

Medals for Cattle Pathology.

72. In the annual examination for the Society's prizes held at the Royal Veterinary College, the Silver Medal was won by Mr. C. V. Davies, of 29, Court Street, Maesteg, Glam., and the Bronze Medal by Mr. M. Kirk, of The White Cottage, Chipstead, Surrey. The examination was conducted by the Professors of the College and comprised written and oral work in the diseases of cattle, sheep and swine.

National Diploma in Agriculture.

73. The popularity of the "N.D.A." is shown by the fact that 208 candidates presented themselves in April last, as compared with 160 last year. Thirteen candidates took the whole Examination, 80 who had previously passed in certain subjects appeared for the remaining portion, and the other 115 candidates came up for a first group of subjects.

Forty-eight candidates were awarded the Diploma, four with Honours. The successful candidates were :—

Diploma with Honours.

1st. Harold Richmond Kirby, Midland Agricultural College.
2nd. Donald Lindsay Sinclair, Harper Adams Agricultural College.

3rd. John Pearce, University of Reading.
4th. Kenneth Norton Russell, University of Reading.

Diploma.

Raymond Hart Aitkenhead, University of Leeds.
Kenneth John Allright, South Eastern Agricultural College.
William Percival John Arthur, University of Reading.
George Henry Beard, Midland Agricultural College.
Paul Benckendorff, Harper Adams Agricultural College.
Horace Haddon Brownlow, Midland Agricultural College.
James Barnard Cureton, Armstrong College.
Sydney Gwyn Davies, University College of Wales.
Anthony John Marsh Davison, South Eastern Agricultural College.
Gordon Sholto Douglas-Jones, South Eastern Agricultural College.
David Stanley Downey, University College of Wales.
Frederick William Dunnett, East Anglian Institute of Agriculture.
Richard Kelland Eminson, Midland Agricultural College.
Walter James Ferguson Gardner, West of Scotland Agricultural College.
Robert Garside, Armstrong College.
Roy Gillard, Seale Hayne Agricultural College.
Frank Edwin Harnett, University of Reading.
Kenneth John Harris, University of Reading.
Leonard Bradberry Hawkes, School of Agriculture, Cambridge.
Alfred John Hayes, East Anglian Institute of Agriculture.
Andrew Howie, University of Glasgow and West of Scotland Agricultural College.
Jean Morris Kedward, University of Glasgow and West of Scotland Agricultural College.
John Keir, South Eastern Agricultural College.
John Thomas Richardson Lockwood, Midland Agricultural College.
Alan George McCall, West of Scotland Agricultural College.
Bedford Hugh Nicholas McNeill, South Eastern Agricultural College.
John Marshall Marsden, Midland Agricultural College.
Henry Corbett Mason, Midland Agricultural College.
Samuel Barr Maxwell, University of Edinburgh and East of Scotland College of Agriculture.
Hamilton Alexander Montgomery, West of Scotland Agricultural College.
Kenneth James Rampling, East Anglian Institute of Agriculture.
Geoffrey Millar Ramsden, Harper Adams Agricultural College.
Elinor Mabel Capon Roper, East Anglian Institute of Agriculture.
Ralph Segal, University of Glasgow and West of Scotland Agricultural College.
James Struthers Symington, University of Glasgow and West of Scotland Agricultural College.
William Thomas Thornycroft, Harper Adams Agricultural College.
Aubrey Ralph Trebble, Midland Agricultural College.
John Pinhey Walker, East Anglian Institute of Agriculture.
William Arthur Wannop, Harper Adams Agricultural College.
Finlay Simpson Watson, University of Edinburgh and East of Scotland College of Agriculture.
Thomas Archibald Willis, Harper Adams Agricultural College.
Stephen Wooldridge, East Anglian Institute of Agriculture.
Charles Oswald Wright, Harper Adams Agricultural College.
Henry Roger Wyeld, Midland Agricultural College.

National Diploma in Dairying.

74. The forty-second annual examination for the National Diploma in Dairying took place in September at the University and British Dairy Institute, Reading, for English and Welsh students, and at the Dairy School for Scotland, Auchincruive, Ayr, for Scottish students. The record number of 110 candidates were examined at the English centre, of whom 61 were awarded the Diploma; and 56 presented themselves at the Scottish Centre, of whom 39 obtained the Diploma.

Following are the names of the successful candidates :—

ENGLISH CENTRE.

Diploma with Honours.

KENNETH NORTON RUSSELL, The University and British Dairy Institute, Reading.

Diploma.

ZOË SUZETTE ANNING, Seale Hayne Agricultural College.
WILLIAM PERCIVAL JOHN ARTHUR, The University and British Dairy Institute, Reading.
BARBARA BADDILEY, Lancs. C.C. Dairy School.
RONDESLEY WILKINS BAKER, University College of Wales.
OLIVER BARACLOUGH, East Anglian Institute of Agriculture.
MARIAN ELIZABETH BARNHAM, The University and British Dairy Institute, Reading.
MARGARET BARRATT, The University and British Dairy Institute, Reading.
MAURICE AGAR BARRETT, The University and British Dairy Institute, Reading.
BARBARA BARTON, Studley College.
JOHN CORTHAN MORRIS BEARDER, Midland Agricultural College.
BARBARA FERGUSON BRODIE, Dairy School for Scotland.
HELEN TRAVIS BROWN, Studley College.
OLIVE BURY, Lancs. C.C. Dairy School.
HELEN RHODA CHAPMAN, Lancs. C.C. Dairy School.
JOAN CAMPBELL COCKBURN, Lancs. C.C. Dairy School.
DOROTHY LUCY GRACE CONNETT, Lancs. C.C. Dairy School.
SARAH LILIAN CORNER, The University and British Dairy Institute, Reading.
JANE EVELYN DAVIES, University College of Wales.
MAY DAVIES, University College of Wales.
ANTHONY JOHN MARSH DAVISON, The University and British Dairy Institute, Reading.
GORDON SHOLTO DOUGLAS-JONES, The University and British Dairy Institute, Reading.
DAVID STANLEY DOWNEY, University College of Wales.
DOROTHY FRANCES DRYDEN, The University and British Dairy Institute, Reading.
HENRY OWAIN EVANS, University College of Wales.
PHYLLIS LEONIE FERGUSON-WALKER, Lancs. C.C. Dairy School.
ISOBEL MARY GARDINER, The University and British Dairy Institute, Reading.
ELUNED GRIFFITH, University College of Wales.
NORMAN WILLIAM GRIFFITHS, The University and British Dairy Institute, Reading.
MARGARET E. HALLIWELL, Lancs. C.C. Dairy School.

FRANK EDWIN HARNETT, The University and British Dairy Institute, Reading.
KENNETH JOHN HARRIS, The University and British Dairy Institute, Reading.
DOROTHY OWEN HARRISON, Lancs. C.C. Dairy School.
LESLIE HAMMOND HEAP, Dairy School for Scotland.
MEGAN GRIFFITH HUGHES, University College of Wales.
DOROTHY MAUDE IRVINE, The University and British Dairy Institute, Reading.
DOROTHY BURGESS JOHNSON, Lancs. C.C. Dairy School.
BETTY MONICA JONES, University College of Wales.
REBECCA HUGHES JONES, University College of Wales.
KENNETH WALTER KEMP, East Anglian Institute of Agriculture.
IVOR ERNEST KETTERINGHAM, Midland Agricultural College.
MARGARET MARY LEWIS, The University and British Dairy Institute, Reading.
MARJORY LEWIS, Lancs. C.C. Dairy School.
HERBERT EDWARD LITTLEWOOD, Midland Agricultural College.
MEGAN OLWEN LLOYD, University College of Wales.
MILLICENT MAY LOVEYS, Seale Hayne Agricultural College.
JOHN COLLINGTON MATTHEWS, Midland Agricultural College.
LESLIE WILLIAM OSBORNE, The University and British Dairy Institute, Reading.
JOHN PEARCE, The University and British Dairy Institute, Reading.
PATRICIA MARY POLDING, Midland Agricultural College.
HANNAH MARGARETTA POWELL, University College of Wales.
KENNETH JAMES RAMPLING, East Anglian Institute of Agriculture.
KENNETH LAMBERT RICHARDS, Seale Hayne Agricultural College.
CATHERINE ROBERTS, University College of Wales.
FLORENCE ELIZABETH STANLEY, The University and British Dairy Institute, Reading.
DORIS MARY STOODLEY, Studley College.
FRANCES ELIZABETH WADE, Midland Agricultural College.
TOM MARCH WAKERLEY, Midland Agricultural College.
PERCY WALKER, Midland Agricultural College.
ANNIE MARY MILDRED WILLIAMS, University College of Wales.
ALICE JEPSON YATES, Lancs. C.C. Dairy School.

SCOTTISH CENTRE.

Diploma with Honours.

EDWARD DAWSON, Whitestake Farm, New Longton, Preston.
GEORGE ORD, Field House, Lesbury, Northumberland.

Diploma.

SARAH MARGARET ATKINSON ARMSTRONG, Cormilligan, Tynron, Dumfreisshire.
JOHN ALLAN BIRCH, Club Nook, Barden, Bolton Abbey, near Skipton, Yorks.
JEAN CRAWFORD BLANE, 106, Prestwick Road, Ayr.
FLORENCE SAMSON BROADFOOT, "Glencairn," Helensburgh, Dumbartonshire.
JOHN ROBERT CLAPHAM, High Throston, West Hartlepool, Co. Durham.
JOHN GARDNER, Carskiey Home Farm, Southend, Campbeltown.
WALTER JAMES FERGUSON GARDNER, Woodside, Maybolo, Ayrshire.
ROBERT GARSIDE, Oak Bank, Grasmere, Westmorland.
MARY GIBSON, 16, Raikes Parade, Blackpool, Lancs.
JANE ELIZABETH EVANS GIRDWOOD, Blackethouse, Eaglesfield, Dumfriesshire.

John William Grant, Rothiemoon, Nethy Bridge, Inverness-shire.
Margaret Annie Gray, Dryhope, Yarrow, Selkirk.
Elizabeth Fenwick Hudson, Stobhill Farm, Morpeth.
William Johnstone, Lambridden, Dalry, Ayrshire.
Ena Alison Jones, 82, Netherby Road, Trinity, Edinburgh.
Robert George Laing, Glengarriff, Helensburgh, Dumbartonshire.
James Lorimer, Glenview, Pennyvenie, Dalmellington, Ayr.
Isabella S. MacCallum, Red Lion Hotel, Buchlyvie, Stirling.
Alastair Macdonald, 8, Dundas Street, Edinburgh.
Margaret Jane Macdonald, Incheril, Kinlochewe, Achnasheen, Ross-shire.
Mary Margaret Walker MacGillivray, Heatherlea, Torphins, Aberdeen.
Dorothy Margaret Garden Macintyre, 28, Deemount Gardens, Aberdeen.
Lachlan MacKinnon, Hillcrest, Balephetrish, Isle of Tiree, Argyll.
Mary MacKinnon, Machair, Heanish, Isle of Tiree, Argyll.
Mona Margaret McLean, Croftallan, Nethy Bridge, Inverness-shire.
Anthony Ian McMillan, Trelawney, Ipswich Road, Annerley, South Brisbane, Queensland, Australia.
Roberta Mary Runcie Mair, Glenmore, Oban.
Edith Milne, Dytach, Portsoy, Banffshire.
Phyllis Margaret Pyper, 23, Riselaw Crescent, Edinburgh.
Catherine Rose, Midcoul, Dalcross, Inverness-shire.
Catherine T. Steele, Brae of Monzie, Crieff, Perthshire.
Isabel Sinclair Stewart, 1, Overtoun Terrace, Dumbarton.
Margaret Love Stewart, Lyle Buildings, Kilmacolm, Renfrewshire.
James Struthers Symington, South Beach Manse, Saltcoats, Ayrshire.
Akbar Ali Tur, Agricultural College, Lyallpur, Punjab, India.
John Carswell Warnock, South Howden, Holytown, Lanarkshire.
Richard Harker Wharton, Mountbarrow Farm, near Ulverston, Lancs.

All the candidates at the Scottish Centre had been students at the Auchincruive Dairy School.

Gold Medal.

75. To contain the portraits of all the recipients of the Gold Medal for distinguished services to agriculture, an Album has been prepared as a permanent record. A very fine casket to hold the Album has been presented to the Society by Major R. A. Dyott. At their meeting on July 28th the Council passed votes of thanks to Major Dyott for his gift, to Major Jervoise for providing the oak from which the casket was made, and to Mr. Bridgeman for the skill he had shown in carrying out the work

Representation of Society.

76. Professor J. A. Scott Watson represented the Society at the Fourth International Grassland Conference held at Aberystwyth in July last; Sir Merrik Burrell attended, on behalf of the Society, a meeting convened by the Ministry of Agriculture on Veterinary Education; and Major Hansford succeeds Mr. Neame on the governing body of the National Institute of Agricultural Botany.

Congratulations.

77. The Council have had the pleasure to congratulate Sir L. Foster Stedman on receiving the honour of knighthood; Sir George L. Courthope on being made a Privy Councillor; and Mr. Burke (President and Honorary Director of the Show) and Mr. Turner (Secretary) on receiving the Coronation Medal from H.M. The King.

By Order of the Council,

T. B. TURNER,

Secretary.

16, Bedford Square,
London, W.C.1.

ANNUAL REPORT FOR 1937 OF THE VICE-PRINCIPAL OF THE ROYAL VETERINARY COLLEGE.

As in former years, the Division of Preventive Medicine of the Royal Veterinary College has received enquiries with regard to various diseases, and continued use has been made of the special eradication services available for contagious mastitis and contagious abortion.

Mastitis.—Stress is laid on the necessity of distinguishing the different kinds of mastitis before attempts at control are made, and of recognizing that many cows which are important sources of infection show few or no symptoms. Most herd infections continue to be of the chronic contagious type which is best dealt with by regular examination of milk samples. Animals thus shown to be infected are milked last. Experimental work has shown that many infected cows can be cured by suitable treatment provided the disease is not of old standing. Experimental investigation is being made on a new method of treating mastitis and other streptococcus infections of animals.

Contagious Abortion continued to be a major source of loss. Enquiries show that it is still not generally understood that cows which have once become infected may remain infected for a long period or for life, that animals which do not abort may, nevertheless, be infected and a potent source of spread, and that yearlings are generally free from infection. There is now ample evidence that satisfactory results may be expected from a policy of blood testing and separation of reactors and non-reactors.

Vaccines are not advisable until a blood test has been made to determine the extent of infection and the possibility of eradication has been considered.

As pointed out in a special report to the Research Committee, an investigation on the diseases of young calves is being made at the Research Institute of the College with the assistance of a grant from the Society. The main concern during the past year has been the condition commonly known as "white scours," which is due to the organism known as *Bacterium coli*. In a survey of the cause of death in 100 cases, it was found that this was the responsible organism in at least 37 per cent. of the animals. On the other hand, it is well known that *Bact. coli* is often found in the body without causing disease, *e.g.*, in the alimentary tract. It was necessary therefore to make a more detailed examination of the strains of *Bact. coli* grown from the dead calves, in order to see whether particular varieties or races of this micro-organism are associated with "white scours." There are certain difficulties in this work, which are referred to in the report to the Research Committee, but from the results obtained it can be said that there *are* special varieties of *Bact. coli* which produce disease in calves and that, while one variety only is usually concerned in the death of an individual calf, more than one disease-producing variety may exist in a particular herd.

Animal Husbandry Department.—Among the many queries which have been received during the past months, the following are selected, since it is felt that the answers might be useful for other owners of live stock.

Pastures for Sheep and Horses.—There is no evidence that any of the parasitic worms which may infect sheep are injurious to horses grazing the same pastures, but it is fairly well known that sheep and horses, which graze in a similar fashion, by "cropping short," do not use a pasture properly when grazed together. Moreover, the urine from sheep, especially when receiving concentrates, fouls patches of the herbage, and horses avoid grazing in close proximity to these patches. It has been shown that a ryegrass and clover hay mixture, grown upon a field which has been heavily grazed by ewes and lambs early in spring, may still carry the "sheep taint" after the hay is cut. An instance in which hunters refused to eat such hay was brought to our notice recently. The sample was sound and of excellent quality in every way—apart from the taint.

Cotton Cake.—Among farmers who rear calves there still seems to be a number who do not realize that cotton cake, especially undecorticated, is an unsafe article of food for young stock. In instances where its use leads to illness among calves, it is not sound reasoning to assume that because it has been used in

previous seasons without apparent harm, the sample of cake must be at fault. Cotton cake does not *always* produce illness when fed to calves, but illness occurs sufficiently often, even with the best of samples, to warrant the warning against its use at all as a concentrate for young calves and young lambs.

Vitamins and Cod Liver Oil.—This department has been consulted on several occasions by pig owners who have suffered losses through using rations for pigs kept on the intensive system, which, when examined, are found to be adequate in respect of proteins, carbohydrates, fats and minerals, but which are deficient in vitamins A and D. The evidence seems to show that when pigs are fed for slaughter at 180 to 200 lb. live weight they can give satisfactory returns with only minimal amounts of vitamin supplements, but that gilts which are to be retained for breeding should receive considerably larger amounts, and that they still require adequate vitamins until they have reared their first litters. Good quality cod liver oil as a source of vitamins A and D, and yeast as a source of vitamins B (complex) and C, should be remembered in this connection. A word of warning to farmers purchasing cod liver oil for feeding purposes seems necessary. There are on the market numerous samples which when tested are found to be most unsatisfactory for feeding purposes. Some consist of shark-liver oil, others of mixtures of heavy mineral oils (*e.g.*, lubricating oils) with cod-liver oil, and several consist of mixtures of these with other substances.

In several instances recently, when the brand of cod liver oil has been changed to one of a reputable nature carrying a guarantee of vitamin content and a low free fatty acid content, trouble among young pigs has disappeared without any further modification of ration or management.

Pregnancy diagnosis tests of samples of urine from pregnant mares, to determine the presence or absence of a hormone which is excreted during pregnancy, have been continued. About 85 per cent. of mares excrete a sufficient amount of this hormone to make the test reliable after the 65th to the 75th day from service ; about 10 per cent., especially maiden mares, aged mares, and those barren for two or more seasons previously, do not produce adequate amounts until from the 85th-100th day from service. A few give unsatisfactory results, even up to the 130th day or later. At present there seems to be no way of determining whether any given mare is normal or not in this respect, but among the 5 per cent. or so which give unreliable results, there are a big proportion which have had reproductive trouble of one kind or another in previous years.

Samples from cows do not give good results on pregnancy test, and we do not propose to extend the testing of samples from cows in future.

SCHEDULED DISEASES.

During the year there has been an unfortunate increase in the number of outbreaks of Foot-and-Mouth Disease and Anthrax, while Swine Fever has shown a very satisfactory decrease.

Foot-and-Mouth Disease.—In the case of Foot-and-Mouth Disease the figures were :—

Year.	Number of outbreaks.	Animals slaughtered as affected or exposed to Infection.
1933	87	7,805
1934	79	10,302
1935	56	12,444
1936	67	5,316
1937	187	31,188

The monthly record of Foot-and-Mouth Disease outbreaks during 1937 in some of the European countries is as follows :—

Month.	Great Britain.	France.	Germany	Holland.	Belgium.
January	2	13	5	1	—
February . . .	1	3	5	3	—
March	—	—	3	5	—
April	—	3	9	26	—
May	—	30	6	9	—
June	3	789	2	—	—
July	9	2,727	7	2	10
August	4	9,327	7	394	319
September . . .	1	21,970	264	11,444	4,090
October . . .	16	32,808	3,295	37,998	14,098
November . . .	64	48,757	11,739		22,331
December . . .	87		21,604		
TOTAL FOR 1937 .	187		36,946		

Bovine Tuberculosis.—The following Table shows the number of animals slaughtered under the Tuberculosis Order of 1925.

Year.	Animals slaughtered.
1933	20,908
1934	22,009
1935	22,203
1936	23,716
1937 (up to 30th Sept.)	17,030

Anthrax.—In the case of this disease the figures are considerably in excess of those for last year.

Year.	Outbreaks.	Animals attacked.
1933	297	345
1934	395	453
1935	386	443
1936	468	551
1937	743	879

Swine Fever.—The figures reveal a very satisfactory decrease, nearly 50 per cent., on those for 1936.

Year.	Number of outbreaks.
1933	1,414
1934	1,832
1935	2,049
1936	1,873
1937	982

Sheep Scab.—With regard to the total number of outbreaks of sheep scab during the year as compared with 1936 the favourable position has been maintained.

Year.	Number of outbreaks.
1933	518
1934	684
1935	477
1936	255
1937	253

Foot-and-Mouth Disease.

During the past three months the cloven-hoofed stock of this country has been exposed to one of the most severe epizootics of foot-and-mouth disease on record. That it did not attain to, or indeed exceed, the magnitude of the 1922-24 outbreak was due not to its less virulent character, but to the highly efficient sanitary police methods that were adopted for its control. The Diseases of Animals branch of the Ministry of Agriculture and Fisheries is entitled to be proud of its achievement in the light of what has happened in various European countries under similar circumstances.

History of the Disease in Great Britain—It would seem that the presence of foot-and-mouth disease was first recorded in England in the year 1839, and that during the subsequent 53 years the country suffered from severe outbreaks of infection. In 1862, the animals at the Royal Agricultural Society's Show

at Battersea were attacked and, in the following year, the disease broke out in the Smithfield Show. In 1869, the disease was made notifiable by the Contagious Diseases (Animals) Act, 1869, but compulsory measures for its suppression were not introduced until 1892. In 1871, 52,000 outbreaks were officially reported, involving upwards of three million animals.

From 1880–84 there were 27,445 outbreaks in which some 800,000 animals were affected. From 1892 until 1922, the number of outbreaks did not exceed 95 in any one year. In the latter year, however, and the two subsequent years, the country was subjected to a virulent visitation similar to that which has recently been experienced, and which threatened at one time to make the disease enzootic once more. During that period there were some 4,500 outbreaks necessitating the slaughter of 136,064 cattle, 76,363 sheep, 60,673 pigs, and 173 goats in respect of which the net cost of compensation was £3,669,032. From 1925 until 1936, there were 1,202 outbreaks, an average of a little over 100 per annum, of which 745 occurred during the years 1925–28.

During the past year, the total number of outbreaks has been considerably increased. Apart from the exceptional period 1922–24, which, in view of the present organization for dealing with the disease, as recently evidenced, is unlikely to occur again, the total expenditure in compensation for slaughter during the years 1925–1937 (November 30th) has been £1,190,449, an average of £91,573 per annum. Assuming the total value of sheep, cattle and pigs in Great Britain to be roughly £150,000,000, this is equivalent to the payment of an insurance premium of 1*s*. 3*d*. per cent. to ensure against the risk of the disease becoming enzootic. There is of course no compensation for consequential losses, which are suffered alike by the occupants of infected premises, owners of stock in infected areas, live-stock auctioneers, market authorities, and others associated with the live stock industry. Such consequential losses are at times severe, but those who suffer most need only compare their lot with that of those who are similarly situated in the continental countries at the present time, and where other methods of control have broken down, to appreciate the necessity for the slaughter policy.

History of the Present Outbreak.—Until the summer of this year, the Continent of Europe had been relatively free from foot-and-mouth disease. Belgium was free during the first six months of the year. The monthly average of outbreaks in Germany was 5·5 during the first eight months of the year, and in Holland 6·6 until the end of July, while in France there were 49 outbreaks during the first five months. These outbreaks were sporadic and benign in character with little tendency to spread. A survey of the epizootology of the wave of virulent disease now

spreading on the Continent shows that the infection was introduced into France in May and June by sheep and pigs imported from North Africa (Algiers and Morocco). It then spread with unusual rapidity to Belgium, Holland, Germany, Switzerland and this country.

The following table of outbreaks illustrates its progress in Western Europe :—

1937.	France.	Belgium.	Holland.	Germany.	Great Britain.
June	789	—	—	2	3
July	2,727	10	2	7	9
August	9,327	319	394	7	4
September	21,970	4,090	11,444	264	1
October	32,808	14,098	37.998	3,295	16
November	48,757	22,331		11,739	64
December				21,604	87

The disease has reached dimensions in the four continental countries such as have not been known for many years, and drastic measures have been imposed (including some restriction of the freedom of movement of human beings) in order to arrest its progress. A recent report from Eupen states that foot-and-mouth disease has shown itself not only among cattle, but among game. Hunters in the Herzogenwald have found the carcases of deer which had died of it, and have killed big game which have afterwards been found to be affected. It must be recognized that when the disease is widespread on the Continent and especially when the responsible virus is of a virulent type, the risk of its spread to this country is almost certain.

Methods of Introduction of Infection.—While there is but little risk of the disease being introduced into this country through the agency of naturally infected susceptible animals (since the importation of live animals from countries in which the disease is prevalent is prohibited), there are numerous other possible channels of entry, amongst which may be mentioned :—

1. Carcases or other animal products.
2. Feeding stuffs.
3. Hay and straw and packing materials.
4. Vegetables and fruit.
5. Movements of human beings.
6. Motor vehicles.
7. Migrating birds.

Several of these possible sources of infection are already guarded against by means of special legislation. In 1926, the presence of the disease was established in fresh pig carcases

imported from Belgium and Holland, and as a result the importation of fresh carcases from the Continent of Europe was prohibited by the Importation of Carcases (Prohibition) Order of 1926. Subsequent investigations carried out by the Foot-and-Mouth Disease Research Committee showed that the virus which is the causal agent could remain infective in the bone marrow of chilled beef for periods up to 42 days, and in that of frozen beef up to 78 days. By arrangement with the Government of the exporting countries the risk of the disease being introduced by such agents has been materially lessened. Further, the Foot-and-Mouth Disease (Boiling of Animal Foodstuffs) Order, 1932, which requires that all animal feeding stuffs, including broken and waste kitchen refuse and meat scraps, shall be boiled before being fed to animals, and the Importation of Meat (Wrapping Materials) Order, 1932, which requires the use of special wrappers for meat imported from countries where the disease exists, and prohibits the use of such wrappers subsequently for feeding-stuffs or bedding for animals, should go far to exclude infection from imported meat.

The risk of infection from hay and straw packing materials is evidently not serious. In only three initial outbreaks during the past twelve years has there been reason to suspect these materials as the possible source. The use of such material as fodder or litter is of course prohibited by the Foreign Hay and Straw Order of 1912, while the Foot-and-Mouth Disease (Packing Materials) Orders of 1925 and 1926 prohibit all such packing materials, whether of foreign or home origin, from being brought into contact with animals and require their destruction when their purpose has been served as packing.

From careful observations which have been made by the Ministry regarding the origin of initial outbreaks of the disease, it is evident that the risk of introducing infection by means of feeding-stuffs, imported vegetables and fruit, and through the agency of human carriers or motor vehicles from abroad, is so remote as to cause little or no anxiety. In the case of migrating birds, however, the position is somewhat difficult. While it is true that the late Sir Stewart Stockman, when Chief Veterinary Officer of the Ministry, was unable definitely to correlate initial outbreaks of foot-and-mouth disease with bird migrations, there is strong reason to suspect that the recent outbreaks in the eastern and south-eastern counties may have been due to this method of importation. In the first place, it is reasonably certain that the virus responsible for the outbreaks was of the same "strain" as that which was causing such devastating effects on the Continent. In each country, when examined, it was found to be the Vallée type "O." In all instances it was characterized by its virulence as shown by the rapid spread of infection from

animal to animal (within even a few hours of the first evidence of the disease being noted an unusually large number of animals showed clinical signs of infection), and by the extensive nature of the lesions. Again, its virulence was shown in those countries where a slaughter policy was not in force, or had been abandoned owing to the widespread nature of the disease, by the severity of the secondary manifestations. While the actual mortality from the virus *per se* does not appear to be much higher than the usually accepted figure, the deaths from secondary complications such as abortion, digestive disturbance, suppurative processes, weakness and inanition, mastitis, and the results of decubitus have been unusually heavy. In some continental countries it is thought that the mortality rate is increasing, but this may be accounted for by the fact that adult animals infected at an earlier period are now succumbing to secondary infections and complications. While the death rate is in general not high, in the case of newly-born or suckling calves it may be as much as 75 per cent., and in newly-born piglets up to 100 per cent. If very young calves and pigs are included in the general mortality rate, the figure would be far in excess of that which is usually recognized, namely, 2 per cent. to 3 per cent., since the so-called hyper-acute form of the disease with sudden death is not common in mature animals.

Another reason for suspecting migrating birds is that in the affected counties several outbreaks occurred simultaneously and without any primary outbreaks or any discernible relationship with one another. Moreover, the disease became heaviest and most widespread at the time of the autumn mass migration of birds, particularly starlings, from the Continent to the eastern and south-eastern counties. One of the most serious features of foot-and-mouth disease is that it may be transported mechanically for relatively long distances. It is not known definitely whether birds are naturally susceptible to the disease, but there is strong presumptive evidence that they can carry the virus mechanically. The virus might be carried passively on contaminated feathers or feet, or the birds might sometimes themselves be infected, or carry the virus in their alimentary canal. Experiments conducted by the Foot-and-Mouth Disease Research Committee have shown that no definite evidence of infection or multiplication of the virus within the body could be established in the case of fowls and certain small birds. In the case of ducks, it was shown that if the virus was introduced into the thickened pads of skin under the toes infection resulted and vesicles appeared on the upper surfaces of the web. The vesicles contined virus, and infection was further transmitted in the same way, but not by ordinary contact. The degree of susceptibility in gulls did not appear to be high; one seagull out of ten developed

a vesicle on the web of the foot following the introduction of foot-and-mouth virus, but attempts at passage to other sea-gulls were unsuccessful, although the vesicle contained virus, as proved by guinea-pig tests. As against the theory that migrating birds were responsible for introducing the infection, it has been suggested that outbreaks should have occurred in the Channel Islands and on the South Coast as a result of infection being carried from France. It seems, however, that migrations from North France take a southerly course, whereas those from Belgium and Holland are westerly. In this event, the localization of the disease in the eastern and south-eastern part of England would be accounted for. If, in fact, infection can be introduced into the county by migratory birds, acting as mechanical carriers, it is difficult to see how effective measures against this risk can be organized.

Methods of Control.—If, at any time, the slaughter policy needed vindication, it has surely been furnished by the results of the recent outbreaks. To have stemmed the tide of invasion and reduced it to a few scattered outbreaks within such a short period is a highly creditable achievement. Those who advocate the employment of less drastic measures such as the use of hyper-immune serum, convalescent serum or mixtures of serum and virus, need only compare the relatively small cost of the recent epizootic in this country with the incalculable loss which has been sustained by the countries in which these measures are employed. They could not do better than visit some of those countries at the present time and obtain first-hand experience of the devastating sequelæ which have followed in the train of foot-and-mouth disease, and assess the actual value of the supposed immunity which results when the disease is enzoötic.

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ANNUAL REPORT FOR 1937 OF THE LATE DR. J. A. VOELCKER, CONSULTING CHEMIST.

THE analytical work done for members of the Society has been similar in nature and extent to that in 1936, and, though there have been changes in agricultural conditions consequent on certain concessions to farmers, these have had little to do with the more directly chemical aspects.

The number of samples submitted by members during the twelve months has been 103 as against 110 last year. As usual, these have been sent, as a rule, not in the ordinary routine, but only when some particular question concerning them has arisen. While the enquiries regarding Castor-bean in feeding stuffs have, happily, been less frequent, those with respect to water supplies, and, in particular, the action of water on metals of one kind and another, have increased, and a considerable amount of useful information has resulted therefrom. There have been, though not with such frequency as in 1936, enquiries about dried grass and the submission of samples dried in different ways. A general agreement has, however, been reached that grass, if reasonably well dried by any of the machines now put on the market, is of increased feeding value and has the virtue of being able to be stored. But no response has been made to the challenge I threw out in my last Annual Report. In this report I pointed out that though analysis, feeding experiments, etc., had established beyond doubt the value of dried grass, the real point that must determine the advisability or otherwise of adopting the practice, in place of haymaking, had never been faced, and that until one has some knowledge of what a grass area would yield as dried grass in the course of a season and what this would cost as compared with yield and cost of the same area converted in the ordinary way into hay, one has not the means of coming to a conclusion as to whether grass drying is a paying concern or not.

Everyone I have spoken to on the subject admits that the test I suggested was the right one, but yet no one has been found to carry it out.

During the year, and largely through the meetings of the International Grassland Congress, much attention has been drawn to the condition of the grassland of England and Wales. It has been said that the greater part of this is in a miserable and neglected state, and all of it in a state that would allow of considerable improvement. Personally, while assenting to the second remark, I am very doubtful whether the case as regards grassland generally is as bad as it is made out to be. And, even now, when the Conference is over, I question whether

the ordinary farmer will have obtained much guidance as to what he is to do with his particular land. Mechanical methods of dealing with grassland and the subsequent hay (or dried grass) crop will, no doubt, effect a saving of time and labour and improve the soil and the turf physically, but more than this is wanted to restore what is now popularly known as "the lost fertility of the soil." Our modern soil-chemists at agricultural colleges and suchlike institutions have, no doubt, added much to our knowledge of the soil and its behaviour in respect of physical change, as also in the classification of soils according to type; but I fear that the farmer and his needs have been to a great extent lost sight of, and that in this matter of improvement of grassland he has been told very little as to how he is to ascertain the deficiencies of his land and how he should treat it manurially.

I am aware that, as one of the "old school," I shall be voted as being "out of date"; yet I doubt whether our soil chemists generally, of the present day, have much experience of practical agriculture or of the needs of the farmer, such as would fit them for acting as advisers. Nor can I admit that the present system, as carried out in the analysis of soils, is capable of giving the necessary guidance. It is comparatively easy to speak of "pH values," "balanced soil fertility," or "mechanical analysis," but the crux is not in the chemical determination of soil constituents, but in the application of the lessons that are to be drawn from an analysis of the soil. No doubt, as time passes and experience grows, we shall find a use for these, more exclusively scientific, determinations; but I think that the time has not yet come, and personally, I find myself much better able to advise about a soil by the older methods than by the more "up-to-date" ones.

Take, for instance, mechanical analysis of soil. It is not unusual, I believe, to give this in a soil report. I have been guilty of doing so myself now and again; but did anyone ever turn the information to a practical issue and bring it to the stage of determining, on the strength of it, for what crops or what system of cultivation a certain soil was best fitted? If even this could be ascertained, a point would be gained, but I am still waiting to find an instance of its beneficial application in practical farming.

Soil analysis, according to the older methods, has, to my mind, a marked value in being able to afford definite guidance as to whether a soil is wanting in vegetable matter, in lime, in potash, in phosphoric acid, nitrogen and other constituents, and this knowledge, if applied by one who has the requisite practical acquaintance to back it up, can hardly fail to be useful.

The subject of grass mixtures—which used to be a very important consideration in the laying down of grassland—appears not to be taking the prominent place it has hitherto done, more

especially in the catalogues of seedsmen and in experiments at agricultural stations and colleges. The breeding of pedigree strains of seed and the subsequent management of the land are now more general subjects of discussion. Indeed, one hears but little now among practical farmers as to the sowing of complicated mixtures of grass and clover seeds, and they, at present, seem more disposed to put down a more or less simple mixture of ryegrass, cocksfoot, and one other grass along with wild white clover, or some other clover. For this it must be allowed that they have good reason, for experience has shown that the successful seeding of land with an expensive mixture of plants of believed high feeding value is very dependent on season and on outside conditions regulating the development of one or other constituent of the mixture. An examination of a pasture, intended as permanent, may, after a few years, be unsuccessful in detecting the presence of this or that particular constituent of the original seed mixture. On the other hand, there is little question that certain soils favour the development of certain grasses, and experience alone will tell which are thus favoured and which not. It is remarkable, too, how certain grasses, though not included in a laying-down mixture, may come to the front. In this connection I recall that in the days when the ryegrass controversy was at its height, in an experiment at Woburn in which I endeavoured to show the difference between a mixture which included ryegrass and one without it, the plot that was supposed to have no ryegrass was soon found to have it in plenty. At that time some of our leading botanists and agriculturists declared that ryegrass was the worst kind of grass, and died away leaving the land bare. Experience has, however, settled the question in favour of ryegrass, which must be considered one of our most useful grasses.

But when we speak of one grass being of better feeding value than another, it is but to emphasize points on which we have really very incomplete knowledge. On what does the feeding value of grass depend? It is really a very hard point to settle, and, while it is usual to speak of the high value of proteins in grasses and to compare grasses, etc., in respect of their protein contents, this way of comparison is by no means fully justified, for carbohydrates, too, have a leading part to play in all nutrition problems. It would seem, however, as if these highly debatable points of the relative nutritive values of different grass constituents, and the combining of the grasses in a suitable mixture for sowing, had given place, in large measure, to matters regarding the after-treatment of the land, however the sward has been originally formed.

If there be then these difficulties in assessing the comparative feeding values of individual grasses, the problem is necessarily

greatly increased when one considers these grasses as forming items in a composite pasture. It is not as if the constituents were all of the same period of duration; each has its particular time at which it is most nutritious; so will it be with the pasture itself—just as certain prominent grasses are at their best at one particular time or have special values as being "early" or "late," so will a particular pasture have its own particular use, and what that is no one should know better than the farmer himself. When, therefore, as is now in contemplation, the attempt is to be made to arrive at a conclusion whether grassland is benefited by the feeding of cake upon it, I confess to having very great doubts as to whether the work and expenditure that are to be incurred in the solution of the problem will be in any way rewarded, or whether a satisfactory reply will be obtained.

In the first place, one might ask on what kind of pasture is the trial to be made? Is it to be newly laid-down or is it to be old grass?; what is the quality of the grass?; what is the nature of the soil?; what has been the past treatment of it?; is it to be in a wet or in a dry part of the country?; what stock is it to be tested by—bullocks or milking cows, young or fattening stock, sheep, either alone or along with cattle?; for how long is the land to be grazed?; what is the cake that is to be fed on the grass—all of one kind or a mixture? All these and many other queries might be put, each of which calls for consideration before a plan is decided upon. And when this is done, it might well be asked—what is to be the deciding factor? What is it that will settle the question? Is it the actual gain of weight of the stock, or the amount of hay (or dried grass possibly) which may subsequently be produced? Or is it to be the improved appearance and condition of the grass, and how is this to be assessed and how to be credited to the right cause, whether the management of the land, the handling of the stock, the season, or, in reality, the cake-feeding?

I have had to do with what seemed to be a much simpler problem—the comparison of the feeding of cake on arable land with the feeding of corn on the same land. This would seem a much simpler matter to decide than the grass question, inasmuch as the difference can be gauged by the actual crop yields, and not by several contributory items, and by estimates of the possible grass improvement. Yet the former question occupied my predecessors and myself for 50 years without leading to any decided conclusion. How then is the proposed experiment on pasture—when there is nothing directly to measure the result by—going to yield a satisfactory result in the course of a few years?

To my mind the only test that can be rightly applied to such a problem as the grass one is the practical one—what profit has the farmer made in either case? What has he to put in his

pocket as the result of the experiment? Even here, experiences will doubtless vary, and they may vary greatly, depending upon the proper handling of the land, the skill shown in the management of the stock, and many other points quite important enough to determine whether success or failure be the outcome. The question put is, accordingly, in my opinion, one that is to be answered by each individual farmer in the light of the circumstances in which he finds himself and the ability that he can display.

Castor Bean.—Having dealt with two subjects that have come more or less prominently before me, I return to some of my "old friends," and those who read my reports will naturally ask me what I have to say about Castor bean.

I am happy to be able to write more hopefully about this, for the past year has certainly shown a marked improvement on its predecessors. To what this is primarily due—whether to a more general recognition by the Trade, by Government departments, by County Council officials, or, I would add, among the agricultural chemists themselves—it is hardly for me to say; but I may express my pleasure at the marked change that has been brought about through the efforts, primarily, of a few, with the "backing-up" of the Royal Agricultural Society of England. I need not recall the work of the Advisory Committee of the Ministry of Agriculture and its now definite ruling that Castor bean is a dangerous ingredient and that, owing to the uncertainty of its distribution in any feeding cake or meal, its entire exclusion must be insisted upon.

It would certainly seem that our importers of such materials made an honourable attempt to clear the market in this country of the imputation that this is a land where one could safely "dump down" cake, etc., with, possibly, variable amounts of castor present, the sellers "chancing" whether the so-called "official sample" would be reported, by the appointed chemist of the Association, as containing over or under the figure which is taken as a maximum. That such sample could not be really "official" or representative is now practically admitted on all hands, and the contention of the Royal Agricultural Society and its chemist has been abundantly justified. Anyhow, the action taken by importers and traders desirous of carrying on business honourably has resulted in the number of cases of the occurrence of Castor, or of its doing harm to stock, being very considerably reduced, and this in spite of the fact that I have heard representatives of the Trade declare before Advisory Committees that Castor is a "natural impurity," and that its presence in feeding stuffs cannot be avoided! My own experience in India led me to a very different conclusion, and now we see who was right. Throughout this long enquiry,

extending over some five years or more, I have been forcibly reminded of the difficulty there was—about the years 1880–85—in securing the purity of linseed cake. The merchants and the cake-makers declared that such a thing as a linseed cake practically free from other seeds and impurities was impossible of realization. But when, after experimentation by myself, the Royal Agricultural Society set a standard up to which a linseed cake should come if it was to be recognized as "pure," the merchants and makers very soon found it possible to comply with what they had previously declared to be impossible! The definition then laid down (1887) by the Royal Agricultural Society has remained the rule from that day to this, and its general adoption has been greatly to the benefit of the farming community.

So can it be with Castor, and I trust that the day is not far distant when this "alien" will be given a wide berth and be restricted to its proper uses.

Fertilisers and Feeding Stuffs Act.—It was mentioned in my last Annual Report that steps were being taken, on the initiative of the Royal Agricultural Society of England, to try to obtain such alteration of the Act as would make it really useful to the farmer. As it turned out, when the Act was being framed the influence of the Trade interests on the Advisory Committee was so strong that, in the end, the Act was found to be so full of provisions for securing the importer, the merchant, and the vendor as to make it difficult for the farmer to secure the advantages which it was intended to confer upon him. This was made very manifest when the Act came to be worked. The chief difficulty experienced was in obtaining a sample upon which action could be taken. The clause in the Act which obliged the taking, at the vendor's store, of any sample on which more than the settlement of a farmer's individual transaction was concerned, practically rendered useless the efforts of County Councils to obtain, through their samplers and inspectors, information regarding the sale of fertilizers and feeding stuffs in a district. Even when this first set of obstacles was got over, there followed the provision that it was not possible to carry the responsibility further without the taking of another sample, with all its former safeguards. The result was that the farmer soon found the Act to be of little use to him, while County Councils, inspectors and other officials ceased to take any interest in its enforcement. Lastly, it has to be said that the attitude of the Ministry of Agriculture, when any case for prosecution was brought to their notice, was to discourage the putting into force of the present penal provisions of the Act.

The records of the working of the Act, collected from over the country, clearly show that, except for being occasionally useful in settling some individual transaction by a farmer, it is virtually a "dead letter."

I had, on numerous occasions, brought this to the notice of my own Committee and, ultimately, the Council of the Society took action in the matter, proceeding to call together representatives of the strictly agricultural interests in the country as apart from the trading section. This body, which was first called together on April 28th, 1936, held several meetings subsequently, all of which were marked by great unanimity of opinion, so that little difficulty was experienced in coming to conclusions, and subsequently in formulating these in proposals for a new Act. They were embodied in a letter to the Minister of Agriculture which also asked for the favour of an interview with the Minister (then Mr. W. S. Morrison, M.P.). The first Chairman of the Special Committee was Mr. Fred Smith of Woodbridge, Suffolk, and on his resignation in December, 1936, his place was taken by Mr. B. J. Gates, a former President of the National Farmers' Union.

The Minister of Agriculture having been kind enough to grant the favour of an interview on the subject, this was held on Tuesday, July 20th, 1937, at the Ministry. The Minister gave a kindly reception to the Deputation and promised to consider carefully the points laid before him.

Manures and Feeding Stuffs.—It cannot be said that agricultural conditions generally have lent themselves to the more extended use of fertilizers or feeding stuffs on the farm. Indeed, the increase of grassland and the saving of labour expense thereby have had the effect of reducing the amounts consumed. On the other hand, it cannot be said that prices have been, on the whole, unfavourable to the purchaser. In the case of fertilizers a slight rise in potash has been experienced, and this, having now been maintained steadily for some time, I have found it advisable to increase the unit value of potash from 3*s*. 3*d*. to 3*s*. 6*d*. This change was made in the Compensation Tables issued in June, 1937. The prices of superphosphate and basic slag have continued unaltered throughout the year. The nitrogenous salts, sulphate of ammonia and nitrate of soda, having undergone the usual fluctuations, but these have hardly been as marked as usual.

Feeding stuffs likewise have not experienced more than the ordinary changes; linseed cake has ranged between £8 7*s*. 6*d*. and £9 7*s*. 6*d*. per ton, and cotton cake between £5 5*s*. and £6 per ton. Groundnut and soya cake have continued in good demand, more especially the oil-extracted soya meal. The quality of wheat offals, as also of barley meal, has very much improved, maize-meal also having upheld its high character.

I now pass to matters of interest in connection with my ordinary laboratory work for Members of the Society.

Action of Water on Metals.—A number of interesting and

important cases were mentioned in my last Annual Report as to the action of waters of different character on metals such as are generally used for pipes. This work, which comprises the action principally on lead and iron pipes, has been continued and extended.

Further samples of the waters which were reported on last year as being badly contaminated by lead were sent me. To counteract the action on the pipes the water had been put through a filter tank filled with limestone. After being in the tank for a week samples of the water were drawn for testing. On examination of these the lead content of the waters was found to be halved, and, in two instances, lead was absent altogether. Some ten months later samples were again sent me and the analysis showed that the improvement brought about by the limestone treatment had been maintained.

In another instance a member sent two samples representing the water supplied by his estate to two schools. Both supplies, which had been in use for 40 years, had been condemned by the Public Health authorities. They were considered unfit to drink as the water, being a soft one, was liable to be contaminated by lead from the pipes conveying it. In one case the water was also stated to be polluted. Analyses of the two samples showed them to be satisfactory both chemically and bacteriologically, and in only one was any lead found, the amount (1/350 grain per gallon) being so small as to be negligible. When the Local Authorities had the water analysed the analyst's results coincided with mine except that he found lead in the sample that I found to be free of this and none in the sample reported on by me to contain a trace of the metal. The conclusion to be drawn was that lead was sometimes present and sometimes not.

Yet another member sent samples of water for examination on account of its action on pipes. The water caused rusting and blocking of the pipes, particularly those conveying the hot water, so that these latter had to be renewed after a few years. A plant which automatically added lime had been installed to treat the hot-water supply, which was used after cooling for drinking, and it was successful in clearing away the rust.

The water, which was rather cloudy on arrival, was found on analysis to be satisfactory chemically, but was of a very soft nature. It contained iron salts in solution and on its way through the iron pipes tended to throw down a deposit which accounted for the blocking of the pipes. The cloudiness and the iron salts could be removed by running the water through a bed of sand, and, had this been done in the beginning, there would, in all probability, have been no need for the installation of the special plant, and it would have provided a fresher and more satisfactory drinking supply.

A water which proved to be of an altogether exceptional nature was submitted for analysis. It had been drawn from a well 127 feet deep after pumping at the rate of 100 gallons per hour for 48 hours. The water contained 254·8 grains per gallon of total solids, just over 86 grains per gallon of chloride of sodium (salt), and 80·64 grains per gallon of sulphates. The water was extremely salty to the taste and quite unfit on that account, as well as bacteriologically, to serve as a regular drinking supply. The turbid condition of the water on its arrival was no doubt due to the 48 hours pumping, and it should have been allowed to settle before a sample was drawn. A further sample taken two months later showed a decided improvement, and a third sample, taken when the water had thoroughly settled down and was in ordinary flow, showed a total solid content of 98 grains per gallon, chloride of sodium (salt) 14 grains per gallon, and just over 34 grains per gallon of sulphates. In addition, the bacteriological examination of this sample proved quite satisfactory.

In yet another instance, where the purchase of a property was involved, a sample of the drinking supply was submitted. The chemical results showed that the water was satisfactory, but the bacteriological results indicated contamination of an organic nature. Before condemning the supply, however, I sent a sterilized bottle and asked for a further sample to be taken. The bacteriological examination of this sample was quite satisfactory, and, on enquiry, it was found that the original sample had been drawn from the well in a not over-clean bucket, which only emphasizes the care required when drawing samples of water for analysis.

A member sent me a sample of "Cod Liver Oil Condiment" especially recommended for pigs. A sow had farrowed a litter of ten very fine pigs and almost directly all but two died. I found the sample to be grossly contaminated by creosote which undoubtedly had caused the death of the young pigs.

Another member submitted samples of cotton cake, bran and flaked maize with the complaint that he had been losing cattle. Nothing amiss could be found with the foods, and it was subsequently ascertained that the animals had died from poisoning by Hellebore (*Hellebore Foetidus*). I am told that this is given to animals to stop their breeding.

A hop grower in Kent submitted a sample of Hop Wash for destroying aphis and fly. Twenty barrels of wash were purchased and six or seven barrels were used for the first two washes, which were quite satisfactory. On washing for the third occasion with the contents of a new barrel, the hops began to change colour. It was found that, by accident, a tar wash had been put in a barrel instead of nicotine and soft soap, and this was the cause of damage

to at least 10 acres of hops. The suppliers admitted the contamination and the damage.

The following is the list of samples sent by members for analysis during the twelve months, December 1st, 1936, to November 30th, 1937 :—

Linseed meal	1
Cotton cake	1
Soya bean meal	1
Compound cakes and meals	7
Cereals, offals, etc.	2
Dried grass	3
Hay	1
Fish meal	1
Whale meat meal	2
Sulphate of ammonia	1
Superphosphate	1
Compound Manures	2
Bone meal	1
Potash materials	4
North African phosphate	1
Shoddy, etc.	8
Lime	2
Milk	1
Soils	20
Waters	28
Miscellaneous	15
	103

For J. AUGUSTUS VOELCKER,
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ANNUAL REPORT FOR 1937 OF THE BOTANIST.

THE work of the Botanical Department during 1937 was, in many respects, very similar to that of the previous year, probably because in both years there were long periods of excessive rainfall. In fact, except for a spell of fine weather at harvest time, the climatic conditions during 1937 could hardly have been worse from an agriculturist's point of view. In only one respect was there a noteworthy difference in the enquiries which had to be dealt with. As a general rule, during the first three months of the year the cause of the failure of wheat and winter oats forms the main subject of enquiries. This year hardly any one wanted a botanist's opinion on the matter, for they could, generally correctly, diagnose the cause as excessive moisture in the soil. Apart from the samples of seeds received for testing during this

period, a few cases of clover sickness were all the Department had to deal with.

With the coming of spring problems associated with the diseases of plants began to come in freely, and by the end of the year they accounted for more enquiries than any other section of the Department's work. But general experience indicated that amongst the staple crops of the farm losses from this cause were smaller than usual. The troubles reported were largely amongst the market garden crops which have found their way on to the farm of late years. Amongst these, outbreaks of disease were common and in some cases disastrous. The causative agents are not yet familiar to growers, and consequently their identification and methods for their control were in request.

Foremost amongst these pests were the "grey moulds." These owe their popular name to the ash-grey colour of the fluffy sheets of spore-bearing branches produced on the dead or dying tissues of their host plants. Some grey moulds are exceedingly common as saprophytes, and as such they play a great part in the rapid destruction of dead plant tissues. But the parasitic forms do not, as a rule, become serious pests on farm crops.

They constitute the group of fungi known botanically as Botrytis, in which there is included a number of forms which, though physiologically distinct from one another, are very similar if not identical in appearance. As spore-bearing ceases the fungus gives rise to black resting bodies (sclerotia). After a resting period, generally of a few months, these again give rise to the fluffy grey mass of spore-bearing branches. Unfortunately they may remain in a viable condition in the soil for several years, much as those of the somewhat similar clover sickness fungus can, and then by starting into growth spread the disease once more. As far as is known with certainty, there are no other stages in the life history of the fungus.

In the annual report for 1936 a brief account was given of an outbreak of the disease, known as "fire," in a commercial planting of tulips. This is caused by a species of Botrytis. The name is due to the scorched appearance of the foliage and flowers when the white flecks—the first signs of infection—have enlarged, coalesced and dried up. The disease in this case was controlled more or less satisfactorily. But it reappeared this year, and by the middle of May it was evident that wherever tulips were being grown there was an exceptionally severe epidemic of the disease. Colloidal sulphur which, used as a dust, had controlled the outbreak the previous season, now proved useless, and an extensive series of trials with various fungicides gave no results which could warrant suggesting their use. As a consequence of this outbreak many stocks of tulip bulbs must be infected. This state can be recognized by the presence of small black sclerotia between the

outer-bulb scales, but in a cursory examination they may be overlooked. Such bulbs, when planted, may decay completely or push up contorted foliage which soon becomes covered with grey mould. If the rows are looked over plant by plant at an early stage of growth and any bulbs with suspicious foliage dug up and carried away for destruction, the centres from which the disease spreads should be eradicated.

The grey mould was also responsible for the destruction of a crop of lettuce. The plants had been kept through the winter in shallow boxes in frames. Just before the time came for transplanting into the open the basal leaves were attacked and the whole lot rapidly rotted. Inadequate ventilation was probably responsible for the trouble, for Botrytis thrives under damp and cool conditions.

The same fungus was found in the "eyes" of rhubarb plants which had been covered over with pots for hastening and blanching the early growth.

Yet another of its host plants was the gooseberry. Pieces of the base of a dying branch when kept under moist conditions soon produced an abundant crop of the unmistakable spore-bearing branches. The disease had been noticed in the plantation for the first time in the previous season, but no attempts had been made to check it.

Onions which were decaying rapidly soon after being dried off for storage also bore a vigorous growth of Botrytis. Whether the infection occurred before lifting or during drying could not be determined. The latter seemed the more probable for the crop was late in maturing, owing to a somewhat generous treatment with artificials, and weather conditions had made it necessary to finish off the process on the earthen floor of a shed.

But the most serious losses amongst these minor crops were due to obscure strawberry diseases. These have spread widely during the past few seasons, and in many parts of the country it now seems impossible to find fields or gardens free from such troubles. In spite of many investigations it still can only be said that viruses are probably the responsible agent. Several of these virus diseases have been described, but their differentiation is difficult. The presence of the disease may be assumed if the leaves in the centre of the plant are smaller than usual, markedly yellow at their edges and possibly crinkled. Plants showing such symptoms either fail to crop or produce a few small berries and then gradually die off. Runners from such plants carry the infection and give rise to further sickly specimens. So far, curing such plants seems to be impossible, and the only way to check the disease is to dig out every plant showing the faintest sign of infection in the hope of securing a supply of sound runners for a restart. Even with the most strenuous rogueing complete

success cannot be guaranteed, and the young beds must be carefully watched and diseased plants removed as soon as possible.

Some years of experience in a garden where the infection is particularly severe (owing to the introduction of diseased plants for investigation) has led to the growing of the crop as an annual. To do so runners are secured as early as possible, the aim being to get these set in their places by the end of July. From these, by dint of watering when necessary and good cultivation, good crops of fruit are secured. But the beds have to be scrapped after picking, for by July a large percentage of the plants show symptoms of the disease. As a commercial proposition such a method of strawberry growing is, of course, impracticable.

Only a few of the many diseases of the potato crop were received for examination. Amongst these were the two common virus diseases "leaf-roll" and "mosaic." In the former the edges of the leaflets roll upwards, tend to thicken and become brittle. The plants are dwarfed and produce comparatively few tubers, which are mainly of seed size. If these tubers are planted the symptoms appear again, generally more pronouncedly. There can be no doubt that this disease is mainly responsible for the steady deterioration of potato varieties. The "running-out" is accelerated by the practice of picking out seed size tubers from a bulk of potatoes for, where infection is present, this amounts to selecting material for the further propagation of the disease. Change of seed, the recognized method of securing healthy crops, owes its value to the fact that the aphides which spread the infection are uncommon in the northern parts of Scotland and Ireland and in the high districts of Wales and Yorkshire. Amongst the best growers, particularly of Scotch seed, it is customary to inspect the fields at an early stage and remove any suspicious plants well in advance of harvest.

The mosaic disease is recognized by the yellow mottling of the foliage. Its presence, too, results in a marked diminution in the yield of the crop.

A third disease, the "dry-rot," caused by the fungus *Fusarium cœruleum*, was again prevalent, particularly in Sharp's Express.

Enquiries made when each report was sent showed that in all cases the seed tubers had been obtained direct from Scotland. Thus a change of seed, though unquestionably valuable, is no guarantee that the crop will be completely free from infection.

One other disease appears to have been rather prevalent. This was the "common scab" due to *Actinomyces scabies*. The trouble was not expected, for it is generally associated with dryness both in the atmosphere and the soil. The rough, corky patches which develop on the skin of the tubers are only superficial and beyond making them unsightly do no further damage.

A non-pathological cause of complaint was the production of curiously misshapen tubers, probably as the result of a check to growth during August.

There is little to be reported with regard to the diseases of cereals. The worst of them is now the one known as "White-heads" (*Ophiobolus*). It undoubtedly becomes commoner every season, especially in wheat. This year again the fruiting stage of the fungus matured by the time the crop was ready for harvest. Identification consequently became a certainty instead of a doubtful matter, as it was a few years ago when there was some difficulty in finding this fruiting stage even on a month-old stubble.

No root diseases of any general interest were reported, and amongst clovers the only unusual disease, though it may be more common than is generally suspected, was the "crown gall" of lucerne (*Urophlyctis alfalfæ*).

The chief troubles reported by fruit growers were apple scab and canker. It was expected that the former disease would be very prevalent owing to the difficulty of carrying out the usual control technique before and immediately after the flowering stage. But the number of enquiries did not indicate that it was worse than usual. The season was again noteworthy for the intensity of the attacks of American gooseberry mildew. The account given of one of the outbreaks which was reported led to a visit being paid to the garden in which it occurred. The bushes were some 10 or 12 years old and growing luxuriantly. Every one was so heavily infected that practically every berry and all of the young twigs were plastered with the fungus. Black currants were also infected. The disease on these was easily controlled by spraying, but the outbreak on gooseberries was so severe that it was considered desirable to grub and burn the bushes.

Opportunities for land cleaning were practically non-existent over much of the country until late in the spring, with the inevitable result that 1937 proved to be an exceptional year for weeds. The outstanding weeds of the cereal crops were wild oats and docks, which, in some districts, were so abundant that the fields were an almost uniform rusty brown colour. The low-growing annual weeds, such as chickweed and speedwell, also grew strongly in the young corn, and often formed a continuous mat in the root crops, which must have made cleaning operations difficult.

The only unusual weed sent in for identification was the slender vetch (*Vicia tetrasperma*). It is not an uncommon plant, especially in waste places, but so far it has not found a place in the list of weeds sent in to the Botanical Department. The report accompanying it made it clear that, where it is well established,

it can be troublesome. The seeds are shed in early August, and it would appear that surface cultivation in the autumn would easily keep the weed from increasing much. But a germination test of the seeds brought out the fact that about 8 per cent. of them were "hard," that is, capable of remaining in a dormant but living condition in the soil for a year or more.

If this result is generally true, the persistence of this weed is easily explainable.

But the difficulty of cleaning the land is not a complete explanation of the weediness of 1937, for much of the pasture of the country was in a far worse state than usual owing to an unusually abundant growth of ragwort. So striking was it that during the late summer some of the daily and weekly illustrated papers published pictures of landscapes in which this weed was the prominent feature.

In some parts of the country, notably on the light soils of East Anglia, ragwort is always a prevalent weed. There pastures are often invaded to such an extent that they lose much of their grazing value, and one wonders why they are not ploughed out, cropped for a season or two and then put down to grass again. Elsewhere, until 1937, such wholesale invasion was unusual. Then fields, on which the plant was either unknown or at the most an occasional weed, suddenly produced a crop of it. This occurrence, judging from the reports received, was general all over the country. No satisfactory explanation of the outbreak has been given so far and the most that can be said for the moment is that it was due to the widespread distribution of the 1935 crop of seed, since the bulk of the flowering plants on newly-infested land were in their second year of growth. One curious feature of the epidemic was the comparative rarity of the caterpillars of the cinnabar moth, which are usually to be found in such abundance on it. They evidently had not caught up with their host, and so could not serve the useful purpose they are supposed to serve in East Anglia, of keeping the weed under control by stripping it of its foliage. Once its general prevalence was realized it was anticipated that further information might be obtained about its toxic properties. But no reports on the subject were received.

The plant is difficult to keep within limits. Repeated cuttings and sheep-grazing help to check its spread, but the only method of eradicating it, short of ploughing out the pasture, is to hand pull it as it begins to flower. On light soils, especially after rain, young plants can easily be disposed of in this way.

Amongst the miscellaneous enquiries received was one asking whether the use of the new mercurial seed-dressings was likely to cause undue mortality amongst rooks and pigeons. As no information on the subject was available an attempt to secure some

is now in progress. One curious specimen sent in for investigation was a broccoli which, on cooking, had turned a bright blue colour. No reference to the phenomenon could be found, and it was only some months later that similar cases were heard of through the kindness of one of the great catering firms. It was found that the blue colour was closely connected with the purple colouring so commonly found in the Brassicæ. As is well known, when a purple leaf of one of these is boiled the purple disappears and the leaf becomes green. But the green colouring matter, or chlorophyll, masks a clear blue shade which can only become evident when the green is absent as it is in the case of the "curd" of a broccoli. To account for the presence of small quantities of the purple pigment in the curd, a genetical investigation on material which happened to be available is in progress.

The number of enquiries dealt with during the year was 131, as compared with 152 in 1936 and 160 in 1935.

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ANNUAL REPORT FOR 1937 OF THE ZOOLOGIST.

There is little of special interest to be recorded concerning the work of this Department during 1937. The pests enquired about have been for the most part well known insects, and their incidence has, as usual, been largely governed by weather conditions. It was noted in last year's Report that "cut-worms"—the caterpillars of Noctua moths—were especially destructive to a large variety of farm crops. Complaints of this pest were comparatively rare during 1937, but its place was largely taken by slugs and chafer grubs. The latter especially were reported to be doing injury to grassland and various crops in many parts of the country, and all three of the common species were concerned—the cockchafer, the summer chafer and the garden chafer. In May, moreover, cockchafers on the wing were reported to be unusually abundant in some districts.

The wet and open winter naturally favoured such pests as slugs, and it seemed to render winter wheat more subject to attack by frit-fly and other insects ; but more serious was its effect in delaying farming operations and necessitating late sowing of certain crops. It was fully anticipated that frit-fly would be very destructive to spring-sown oats, but as regards the June attack this was only partially realized. Complaints were fairly numerous, but the damage as a rule was not great. It was much more conspicuous at harvest time, when the second brood of the

fly caused many "blind" heads in some oat crops and substantially reduced the yield.

In April, various species of Aphis began to appear on fruit trees, and were the heralds of rather severe attacks. They were, of course, most numerous on unsprayed trees, but the wet season had rendered spraying less effective than usual and it had not conferred the ordinary degree of immunity from attack.

The hot spell of weather in the latter part of August favoured such pests as red-spider, which quickly became rather seriously injurious. It apparently came too late, however, to encourage flea-beetle attack, and on the whole "turnip-fly" and its relations were not very destructive. There were, however, several complaints of unusually severe attacks on leguminous crops of the weevil *Sitona lineata*.

The following notes record anything that appears of interest under the heading of the various crops :—

Cereals.

Winter wheat suffered from a variety of pests. Wireworm and leatherjacket were very active in the mild winter season, and much harm was done by slugs and frit-fly, but cut-worms, so noticeable last year, were seldom complained of. In East Anglia there were again cases of injury by the "mud-beetle" *Helophorus nubilis*.

As in 1936, early sowing of spring crops was impracticable in most districts, but the expected attack of frit-fly in oats during June was not very fully realized, though at harvest time it was found that the second brood of the fly was more than usually prevalent in the ears and had some effect in reducing the yield. Cases of wheat bulb-fly were reported, and gout-fly in barley was the subject of some enquiries.

Farm and Garden Crops.

In last year's Report a full account was given of the Asparagus-fly, *Platyparea pœcilloptera*, which I found had established itself at one spot in England, a country where it was previously unknown. No further cases have been reported to me, but the matter was taken up by the Ministry of Agriculture and Fisheries, and I understand that additional instances of attack have been discovered—as indeed was fully expected. So far as the area infested seems to be fairly restricted, but the insect has clearly obtained a footing in the country, and in view of its great destructiveness it behoves all growers of asparagus to be on the look out for its first appearance and to take measures against it without a moment's delay.

Most of the pests which attack vegetables in gardens and allotments were more than usually abundant this season, notably

carrot-fly, onion-fly, and celery-fly, and cases of injury by chafer grubs were not uncommon.

Fruit Crops.

Various species of Aphis were very much in evidence on fruit trees in May, and not only on unsprayed trees, for the wet weather in February and March had caused the tar distillate washes to be less effective than usual in some orchards. Some of the other pests, notably apple-blossom weevil and raspberry beetle, were more abundant than of late years. In the hot August weather there were some severe outbreaks of red-spider attack. Codlin moth attack continues to be widespread, and in some districts severe. The researches of various entomologists, notably Mr. W. Steer of East Malling, have somewhat changed the prevalent views as to the habits of this pest. It is found, for instance, that in the case of apples the eggs are more often laid on the sides of the fruit than in the crown, whereas the reverse is true in the case of pears. There has been much question as to the existence of a second brood of the codlin moth. The egg-laying season is so long—from the last week in June to the first week of August—that a clear separation of broods is difficult. The verdict seems to be that there is normally only one brood, but that in exceptional seasons moths from the June eggs may give rise to a modified attack in September. Other fruit pests enquired about were pear slug-worm and apple saw-fly.

In July, 1936, Mr. Petherbridge, at Cambridge, received specimens of Norfolk Giant raspberries which were infested by a caterpillar which he did not recognize. On breeding out it proved to be the caterpillar of the "blue" butterfly, *Lycæna argiolus*. Hitherto butterflies have been regarded as of no economic importance, except the "Whites" (*Pieridæ*), to which group the familiar cabbage butterflies belong, and this is, as far as I know, the first instance of damage being attributed to a member of the *Lycænidæ* or "Blues."

Forest Tree Insects.

Among the few enquiries received under this head, two concerned pests seldom complained of. The first was a severe attack of aphis (*Phillaphis fagi*) on beech trees. The other was an infestation of junipers by the moth *Dichomeris marginellus*, an insect rather remarkable in having no alternative food plant but feeding only on the juniper.

Here, perhaps, may be mentioned a case of injury to bell heather referred to me in October. It was found to be attacked by the scale insect *Ericococcus devoniensis*. The specimens sent were flecked with large numbers of small white objects which proved to be packed with the eggs of the scale insects which had

been injuring the heather but were now all dead. As some of the sacs contained hundreds of eggs, it was clear that the pest had made ample provision for future attacks; but a method of control was equally clear. It seemed likely that the whole brood would be destroyed by burning the heather at this time of the year.

Animal Parasites.

Some ticks sent from sheep in Somerset proved to be *Dermacentor reticulatus*, a species comparatively rare in this country, where the usual sheep tick is *Ixodes ricinus*. Ticks were also sent for identification from Uganda, and from Iraq an application was received concerning ticks responsible for a high percentage of mortality in fowls. The species was *Argas persicus*, a widely distributed fowl tick known to convey the disease of spirochætosis.

In March last a case of an epidemic among rabbits in the Isle of Wight was referred to me, though it would have been more appropriate to consult the Veterinary College. I could find no parasitic cause of death in the specimens sent, but thought it probably due to dysentery induced by the excessive wetness of their food in that rainy season.

Miscellaneous Notes.

Insects not necessarily of economic importance are often sent to this Department for identification by members who have either been struck by their unusual appearance, or who desire information as to their habits, and among those received during the past year several had points of interest which appear deserving of a brief note. The large and formidable-looking wood-wasp, *Sirex gigas*, is an annual example, and has been dealt with in previous Reports.

A member sent me a specimen of what his gardener had quite correctly informed him was a carnivorus slug. This is the *Testacella*, a small slug which may be recognized at once by the presence of a little circular plate or shell at its hind end. Its habits are interesting. It feeds on earthworms, which it pursues along their burrows like a ferret after a rabbit. The object of posterior shell is supposed to be to protect its rear in case another Testacella should be following on the same quest.

Correspondents sometimes enquire as to the cause of a curious injury to rose leaves. The leaves are not eaten irregularly, caterpillar fashion, but pieces are cut out, some almost perfect circles, and others oval, with surprisingly clean-cut borders. This is the work of the leaf-cutter bee, *Megachile*, which requires the leaves not for food, but for making its cartridge-like cells which it fills with honey, and in each of which it lays an egg. I have found numbers of such cells in the rotten wood of an old

fence. The egg hatches into a grub, which has sufficient food in the cell to complete its development into a bee. The circular pieces of leaf serve for the ends of the cylindrical cell, while the oval cuttings are used for the sides.

One correspondent sent me a specimen of a large beetle, entirely unfamiliar to him, which he had found in the garden. It proved to be the great water beetle, *Dytiscus marginalis*. Its early life is passed entirely in the water, where its formidable-looking grub preys on small water animals, but the beetle is amphibious, though more at home in the pond. Aquarium specimens will sometimes leave the tank and fly about the room in the evening.

Another insect that often attracts attention by its odd appearance is the wasp-beetle, *Clytus arietis*. It is about half-an-inch long, and banded somewhat like a wasp. Though not regarded as a serious pest, this beetle is more or less injurious to timber, its grub usually living in fences or other dead wood.

Two enquiries concerned the curious little insect known as the "silver fish," *Lepisma saccharina*. Most kitchens will furnish a few examples, and on opening a kitchen drawer the little creature may often be seen gliding away into a dark corner. *Lepisma* feeds on the debris of food, mostly of a starchy nature, and when abundant is capable of doing considerable injury to the binding of books and the mounts of pictures, attracted apparently by the paste employed. To an entomologist, its chief interest is as a survival from the age of primitive insects before the development of wings.

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THE SOCIETY'S TRACTOR TESTING SCHEME.

THE first tests under the R.A.S.E. Tractor Testing Scheme were carried out by the Institute for Research in Agricultural Engineering during September, 1937. This scheme, which was drawn up by the Society after prolonged discussions with representatives of the Society of Motor Manufacturers and Traders, The Agricultural Engineers' Association, The Tractor Users' Association, and the Agricultural Machinery Testing Committee of the Ministry of Agriculture and Fisheries, has as its object the provision of a permanent means by which tractors intended for sale in Great Britain can be tested. The main features of the scheme are that the tests shall be carried out on strictly practical lines so as to provide information of direct value to farmers, and that they

shall involve a minimum of expense to the entrants of machines. The conditions of entry as finally drawn up were as follows :—

(1) All entries must be made on the prescribed form and must be received by the Secretary, R.A.S.E., 16, Bedford Square, London, W.C.1, together with the entry fee of £5 per tractor, not later than the last Saturday in April of each year.

(2) All tractors entered for test must be standard agricultural models. Where necessary, entrants must produce evidence that their tractors are regularly available for sale in Great Britain and that adequate service facilities are available in respect of them.

(3) Every entry form must be accompanied by a full specification of the tractor concerned as printed in the advertising literature of the entrant or manufacturer, and, in the case of tractors which have previously undergone official tests at Nebraska or Oxford, by a copy of the appropriate report of test.

(4) The Committee reserve the right to take any steps which they may consider are necessary to ensure that the machines submitted for test are standard models conforming in all respects to the specifications submitted by the entrants.

(5) The number of tractors to be tested in the Autumn of each year will be strictly limited to 12 machines. These machines will be selected by ballot from the total entries submitted. Any machines not so selected, up to a limit of a further 12, will be tested in the following Spring, but Spring tests in any year will only be carried out on tractors entered on the original date, *i.e.*, in April of the previous year.

(6) The Autumn tests will start as early as possible on or after the second Monday in September each year. Any subsidiary Spring tests will start as early as possible after the beginning of March each year. Each entrant will be given a clear fortnight's notice of the place and time at which the machine must be delivered for test.

(7) Every entrant will be responsible for moving his tractor from one site to another as may be necessary during the tests. The Committee reserve the right to disqualify any machine which is not delivered or moved from one site to another in accordance with the instructions given.

(8) The following tests will be carried out on each machine :—

(*a*) A test to determine the maximum average horse-power that can be developed while ploughing in any one gear selected by the entrant. The load will be adjusted by altering the setting (*i.e.*, depth and width of cut) of the plough as required. The maximum horse-power recorded will be the greatest average value developed over the full length of furrow from headland to headland subject to the conditions that the average speed of travel shall not exceed the nominal speed for the particular gear concerned by more than 10 per cent. (due allowance being made for wheel lugs or strakes), and that the wheel or track slippage on either drive wheel or track shall not exceed 15 per cent.

(*b*) A test to determine the maximum average horse-power that can be developed while cultivating in the same gear as in test (*a*). The load will be adjusted by altering the number and depth of penetration of the cultivator tines as

required. Additional adhesion devices may be fitted if the entrant so decides, provided that any such devices are standard fittings for the particular tractor concerned.

(c) A test to determine the maximum drawbar pull that can be sustained while pulling a plough on firm land in bottom gear.

(d) Ploughing tests of eight hours' duration on both heavy and light land, during which the average power developed, the average rate of working, and the fuel consumption will be measured. The test will be carried out at any load selected by the entrant not exceeding the maximum recorded in test (a).

The crankcase will be filled with new oil before the start of the first ploughing test and samples will be drawn on two occasions for dilution analysis.

(9) Throughout the tests every tractor will be driven by a representative appointed by the entrant. Each entrant must give his driver, or some other person who is in attendance at the time of test, authority to give a decision on his behalf on any matter which may arise concerning the tests.

(10) Every entrant may, if he so desires, supply ploughs for use with his tractor during the tests. If necessary, however, ploughs and cultivators will be supplied by the Committee, except in the case of tractors requiring a plough or ploughs turning more than five furrows. In the latter case the entrant will be required to supply suitable ploughs and cultivators for all tests.

(11) All fuels used during the tests will be of standard grades and will be supplied by the Committee.

(12) Entrants must supply their own lubricating oils and must provide sufficient crankcase oil to refill their tractors three times during the tests if required.

(13) All tractors, and their drivers, must be placed at the disposal of the Committee after the conclusion of the tests for a period equivalent to not more than one day's ploughing if required to complete the ploughing or cultivating of any field used in connection with the tests.

(14) The decision of the Committee on all matters relating to or arising from the tests is final and must be so accepted by the entrant.

The scheme of test outlined above differs from previous official tests in this country in two respects: drawbar tests only are included, while all of these are to be carried out with ordinary implements under practical farming conditions. The scheme, in fact, recognizes, on the one hand, that drawbar work in cultivation is the most important function of the tractor and, on the other, that the information most urgently required by farmers in regard to any particular machine is the rate of working and fuel consumption in ordinary farming operations. At the same time, the scheme provides for measurements of drawbar pull, speed and the width and depth of working, so that accurate comparisons with the performances of the machines concerned

both in more formal engineering tests and in work of other types of land can be made. That, except in one instance, the tests are confined to work in ploughing is due not to any idea that ploughing is outstandingly more important than other cultivating operations, but to the fact that, at present, it is impossible to define the conditions of working in other operations closely enough to make the results of tests carried out at different times, and on different land, at all comparable with one another. Thus the results of the ploughing tests carried out in September include not only an accurate record of what each tractor achieved on the individual plot which it ploughed but also a comparative estimate, based on the measurements made during the tests, of what each tractor would have accomplished on land with characteristics representing the "averages," for heavy and light land respectively, of all the plots concerned. Future tests under the scheme will be carried out on land selected with these average characteristics in mind so that results obtained from year to year will be as nearly comparable as it is possible to make them. As a matter of general interest it may be noted that the average ploughing resistances deduced during this series of tests were 14 lb. per square inch of furrow section on the heavy land (Kimmeridge clay) and 7·5 lb. per square inch on the light land (sandy loam). These values may be compared with values of rather under 5 lb. per square inch for a dry blowing sand and rather over 20 lb. per square inch for a Worcestershire clay (in a hard-baked condition after a dry summer), which figures probably represent something like the limits of lightness and heaviness respectively for this country.

All the tests were carried out privately and no public demonstration was held in connection with them. Indeed, such a demonstration would have been superfluous, for all the tractors concerned are ordinary models which can be seen at work on commercial farms. The test results have already been published in the form of a separate detailed report for each entry, and these can be obtained, price 2d. each (post free), from The Institute for Research in Agricultural Engineering, University of Oxford. A summarized general report is given below. One caution in regard to the results is perhaps necessary: that in comparing them with the results of other tests due regard should be paid to the different conditions under which they were carried out. Thus, for example, in every test under the present scheme the tractors were required to move off from a standstill under full load, as they would frequently be compelled to do in practice. In most other official tests artificial loading appliances are used, so that the full load need not be applied until the tractor is moving at normal speed, while further adjustments can be made as required during the test itself.

ENTRIES.

Entries of 17 machines were received in April, 1937, and from these the following 10 were selected by ballot for test during the following September :—

Official No.

1. International TracTractor, T.D.35 Tracklaying Tractor : 4-cylinder vertical compression-ignition engine starting on petrol, changing automatically to run on light diesel oil ; bore $4\frac{1}{2}$ in. ; stroke $6\frac{1}{2}$ in. ; crankshaft speed 1,100 r.p.m. Entered by the International Harvester Co., of Great Britain, Ltd., 259, City Road, London, E.C.1.
2. "Caterpillar" Diesel R.D.4 Tracklaying Tractor : 4-cylinder vertical compression-ignition engine starting by auxiliary petrol engine, running on light diesel oil ; bore $4\frac{1}{4}$ in. ; stroke $5\frac{1}{2}$ in. ; crankshaft speed 1,400 r.p.m. Entered by Jack Olding & Co., Ltd., 101, Grosvenor Road, London, S.W.1, and H. Leverton & Co., Broad Street, Spalding, Lincs.
3. Case Roadless Model L. Tracklaying Tractor : 4-cylinder vertical engine starting on petrol and running on vaporizing oil ; bore $4\frac{5}{8}$ in. ; stroke 6 in. ; crankshaft speed 1,100 r.p.m. Entered by Roadless Traction, Ltd., Gunnersbury House, Hounslow, Middlesex.
4. Massey-Harris 25/40 Wheel Tractor : 4-cylinder vertical engine starting on petrol, running on vaporizing oil ; bore $4\frac{3}{8}$ in. ; stroke $5\frac{3}{4}$ in. ; crankshaft speed 1,200 r.p.m. Entered by Massey-Harris, Ltd., Ashburton Road, Trafford Park, Manchester.
5. Massey-Harris Pacemaker, Wheel Tractor : 4-cylinder vertical engine starting on petrol, running on vaporizing oil ; bore $3\frac{7}{8}$ in. ; stroke $5\frac{1}{4}$ in. ; crankshaft speed 1,200 r.p.m. Entered by Massey-Harris, Ltd., Ashburton Road, Trafford Park, Manchester.
6. Fordson Roadless Tracklaying Tractor : 4-cylinder vertical engine starting on petrol, running on vaporizing oil ; bore $4\frac{1}{8}$ in. ; stroke 5 in. ; crankshaft speed 400–1,400 r.p.m. Entered by Roadless Traction, Ltd., Gunnersbury House, Hounslow, Middlesex.
7. Fordson Land Utility Pneumatic-tyred Wheel Tractor: 4-cylinder vertical engine starting on petrol, running on vaporizing oil ; bore $4\frac{1}{8}$ in. ; stroke 5 in. ; crankshaft speed 1,100 r.p.m. Entered by the Ford Motor Co., Ltd., Dagenham, Essex.

TABLE II.

8-HOURS PLOUGHING TEST ON HEAVY LAND (WHEAT STUBBLE ON KIMMERIDGE CLAY).

Official Number of Tractor.	Name of Tractor.	Gear.	Plough Used.	Mean Furrow Dimensions. Width. In.	Depth. In.	Length. Chains.	Mean Speed. M.P.H.	Mean Pull. Lb.	Mean H.P.	Ratio % Actual H.P. / Max. H.P	Fuel Consumption, Lbs. per H.P.-Hour.	Mean Resistance of Land. Lb./Sq. In.	Acreage Ploughed and Fuel per Acre. As Recorded. Acres Ploughed per Hour.	As Recorded. Fuel per Acre Galls.	Corrected to Standard Conditions. Acres Ploughed per Hour	Corrected to Standard Conditions. Fuel per Acre Galls.
1	I.H.C. TD.35 . .	2nd	I.H.C. 2 × 4 Furrow	9·8	5·6	23·4	2·12	5,160	29·2	94·8	0·58	11·8	1·48	1·37	1·27	1·59
2	Caterpillar R.D.4 .	2nd	Ransome "Hexatrac" 6-Furrow	9·5	6·0	24·6	2·37	4,220	26·7	95·4	0·59	12·3	1·32	1·48	1·27	1·49
3	Case "L" Roadless .	2nd	Ransome "Multitrac" 4-Furrow	9·5	6·0	16·6	2·36	3,620	22·8	80·6	0·86	15·9	0·78	3·00	0·97	2·42
4	Massey Harris 25/40 .	2nd	Massey Harris 4-Furrow	9·5	5·9	22·8	3·10	2,380	19·7	86·0	1·20	10·6	1·10	2·55	0·89	3·15
5	Massey-Harris Pacemaker .	2nd	Ransome R.S.L.M. 3-Furrow	9·0	5·3	21·8	3·04	1,910	15·5	91·7	1·07	13·4	0·79	2·52	0·73	2·74
6	Fordson "Roadless"	2nd	Ransome R.S.L.M. 3-Furrow	9·0	5·6	14·7	2·71	1,950	14·1	84·4	1·21	12·9	0·51	4·04	0·47	4·34
7	Fordson "Green Spot" Utility . . .	2nd	Ransome R.S.L.D. 2-Furrow	9·0	5·8	12·3	3·21	1,670	14·3	90·5	1·18	16·0	0·49	4·15	0·59	3·46
8	Fordson "Red Spot" Agricultural . .	1st	Ransome R.S.L.M. 3-Furrow	9·0	5·7	12·6	2·30	2,370	14·5	98·6	1·42	15·4	0·57	4·85	0·65	3·82
9	John Deere, B.R. .	1st	Ransome R.S.L.D. 2-Furrow	9·0	4·6	21·2	2·23	1,310	7·8	84·8	1·20	15·8	0·41	2·75	0·38	2·92
10	Bristol . . .	1st	Ransome R.S.L.D. 2-Furrow	9·0	6·1	13·9	1·57	1,340	5·6	90·3	0·98	12·2	0·28	2·69	0·27	2·77

TABLE

Official Number of Tractor.	Name of Tractor.	Fuel Used.	Nominal Weight.	Nominal Speeds.			Max. Ploughing on Firm		
				1st	2nd	3rd	Gear.	Mean Speed	Ratio. Actual Speed. / Nom. Speed %.
			Lb.	M.P.H.	M.P.H.	M.P.H.		M.P.H.	
1	I.H.C. TD.35 . .	Diesoline .	10,528	1·75	2·25	2·75	2nd	2·14	95
				(+ 3·25 & 4·00)					
2	Caterpillar, R.D.4 . .	Diesoline .	9,470	1·70	2·40	3·00	2nd	2·36	98
				(+ 3·70 & 5·40)					
3	Case "L" Roadless .	T.V.O. .	10,800	1·87	2·43	3·25	2nd	2·48	10:
4	Massey Harris 25/40 .	T.V.O. .	4,919	2·89	3·75	4·62	2nd	3·24	86
5	Massey Harris Pacemaker	T.V.O. .	3,700	2·46	3·28	4·09	2nd	3·34	102
					(+ 8·66)				
6	Fordson "Roadless" .	T.V.O. .	6,270	1·40	2·30	3·90	2nd	2·51	109
7	Fordson "Green Spot" Utility . . .	T.V.O.. .	3,840	2·04	3·09	4·31	2nd	2·82	91
8	Fordson "Red Spot" Agricultural . .	T.V.O. .	3,360	1·98	3·01	5·29	1st	2·12	107
9	John Deere, B.R. . .	T.V.O. .	2,889	2·34	3·50	4·67	1st	2·08	89
					(+ 7·30)				
10	Bristol . . .	Commercial Spirit .	2,350	1·66	2·80	4·90	2nd	2·32	83

Notes on Table I.

(1) In the case of the steel-wheeled tractors (Nos. 4, 5, 8 and 9) the nominal

(2) The maximum ploughing horse-power tests of the Massey-Harris 25/40 and exceptions all the above tests were carried out on heavy land (Kimmeridge clay).

Notes on Table II.

(1) The standard heavy-land conditions referred to in the table are: Average

(2) The tests of the Massey-Harris 25/40, Fordson Roadless, John Deere and priate time allowances were made.

Notes on Table III.

(1) The standard light-land conditions referred to above are: Average depth of

(2) The tests of the Case Roadless, Massey-Harris 25/40, John Deere and Bristol time allowances were made.

I.

Horse-Power Stubble. Mean Draw-bar Pull. Lb.	H.P.	Wheel or Track Slip. %	Maximum Pull. 1st Gear on Firm Ground. Lb.	Power Developed in Cultivating Rough Loose Fallow. Gear.	Mean Speed M.P.H.	Mean Pull. Lb.	H.P.	Slip. %	Oil Dilution. Grade of Oil Used.	After 8 Hours Running at Full Load. Dilution %	Over Full Period of Test at Various Loads. Approx. Running Time. Hours.	Dilution. %
5,400	30·8	1·5	8,900	2nd	2·05	5,600	30·6	—	Mobiloil Arctic	5·0	15½	0·0
4,440	28·0	2·2	8,000	2nd	1·98	5,000	26·4	—	Mobiloil A	2·0	16½	0·0
4,275	28·3	2·5	6,300	2nd	2·34	3,900	24·3	6·6	Triple Shell	9·6	13	13·2
2,650	22·9	1·0	3,970	2nd	2·60	2,600	18·0	24·1	Mobiloil A	11·4	12½	13·3
1,900	16·9	6·0	3,820	2nd	2·97	1,700	13·5	11·1	Mobiloil A	6·7	16½	12·7
2,500	16·7	6·0	3,700	2nd	2·64	1,750	12·3	3·2	Triple Shell	6·4	17¼	7·1
2,100	15·8	14·2	3,500	2nd	3·03	1,650	13·3	12·4	Essolube 50	4·7	19	7·6
2,600	14·7	15·0	3,350	2nd	2·97	1,350	10·7	14·0	Essolube 50	5·7	17¾	6·1
1,660	9·2	12·0	2,050	1st	2·42	1,100	7·1	11·3	Triple Shell	4·3	16	6·5
1,210	7·5	3·0	2,000	1st	1·33	1,500	5·3	17·0	Triple Shell	3·4	11½	3·4

peeds given in this report refer to the tractor when fitted with wheel lugs as used in the tests.
Bristol Tractors (Nos. 4 and 10) were carried out on light land (sandy loam). With these

lepth of ploughing, 5·5 inches; Mean resistance of land, 14 lb. per square inch of furrow section.
Bristol Tractors (Nos. 4, 6, 9 and 10) were interrupted by a heavy thunderstorm and appro-

ploughing, 5 inches; Mean resistance of land, 7·5 lb. per square inch of furrow section.
ractors (Nos. 3, 4, 9 and 10) were interrupted by a heavy thunderstorm and appropriate

TABLE III.

8-HOURS PLOUGHING TEST ON LIGHT LAND.

Official Number of Tractor.	Name of Tractor.	Gear.	Plough Used.	Mean Furrow Dimensions. Width. Ins.	Mean Furrow Dimensions. Depth. Ins.	Mean Furrow Dimensions. Length. Chains.	Mean Speed. M.P.H.	Mean Pull. Lbs.	Mean H.P.	Ratio % Actual H.P. / Max. H.P.	Fuel Consumption, Lbs. per H.P.-Hour.	Mean Resistance of Land. Lb./Sq. In.	Acreage Ploughed and Fuel per Acre. As Recorded. Acres Ploughed per Hour.	As Recorded. Fuel per Acre Galls.	Corrected to Standard Conditions. Acres Ploughed per Hour	Corrected to Standard Conditions. Fuel per Acre Galls.
1	I.H.C., TD.35 .	4th	I.H.C. 2 × 4-Furrow	9·8	5·0	7·0	3·21	3,030	25·9	92·8	0·61	7·7	1·85	1·02	1·91	0·99
2	Caterpillar R.D.4 .	2nd	Ransome 6-Furrow + 5-Furrow	9·5	5·5	11·4	2·47	3,610	23·8	85·0	0·65	6·3	2·24	0·82	2·08	0·88
3	Case "L" Roadless .	2nd	Ransome "Hexatrac" 6-Furrow	9·5	4·8	15·4	2·50	2,740	18·3	64·7	0·95	10·0	1·22	1·71	1·56	1·34
4	Massey Harris 25/40	2nd	I.H.C. 2 × 4-Furrow	9·8	4·7	7·0	3·15	2,640	22·2	97·0	1·03	7·2	1·70	1·62	1·53	1·80
5	Massey Harris Pacemaker.	2nd	Massey Harris 4-Furrow	9·5	4·8	10·9	3·28	1,030	9·0	53·2	1·67	5·6	0·90	1·99	0·66	2·73
6	Fordson "Roadless"	2nd	Ransome "Multitrac" 4-Furrow	9·5	5·5	14·1	2·74	1,960	14·3	85·6	1·14	9·4	0·87	2·27	1·20	1·64
7	Fordson "Green Spot" Utility	3rd	Ransome R.S.L.M. 3-Furrow	9·0	5·8	16·0	4·07	810	8·8	88·0	1·65	5·2	1·08	1·62	0·86	2·02
8	Fordson "Red Spot" Agricultural	2nd	Ransome "Motrac Major" 4-Furrow	9·0	5·7	14·4	3·28	1,210	10·6	81·5	1·50	5·9	1·16	1·65	1·04	1·83
9	John Deere, B.R. .	1st	Ransome "Motrac Major" 4-Furrow	9·0	4·8	12·3	2·16	1,250	7·2	78·2	1·24	7·2	0·64	1·67	0·59	1·82
10	Bristol . .	2nd	Ransome R.S.L.M. 3-Furrow	9·0	4·8	10·3	2·24	1,170	7·0	93·3	0·91	9·0	0·50	1·73	0·58	1·49

8. Fordson Agricultural Wheel Tractor: 4-cylinder vertical engine starting on petrol, running on vaporizing oil; bore $4\frac{1}{8}$ in.; stroke 5 in.; crankshaft speed 1,100 r.p.m. Entered by the Ford Motor Co., Ltd., Dagenham, Essex.

9. John Deere Model B.R. Wheel Tractor: 2-cylinder horizontal engine starting on petrol, running on vaporizing oil; bore $4\frac{1}{4}$ in.; stroke $5\frac{1}{4}$ in.; crankshaft speed 1,150 r.p.m. Entered by F. A. Standen & Sons, Ltd., Stanpoint Works, St. Ives, Hunts.

10. Bristol Tracklaying Tractor: 2-cylinder horizontal opposed engine starting and running on petrol; bore $3\frac{1}{8}$ in.; stroke 4 in.; crankshaft speed 2,000 r.p.m. Entered by Bristol Tractors, Ltd., Blakehill Works, Bradford Road, Idle, Bradford, Yorks.

Results of Tests.

All tests were completed during the week September 13th–17th. The weather was not ideal; in fact, practically the only rain recorded in the district between mid-July and the end of September fell during the tests. The rain, however, did not seriously interfere with the tests, and in the one or two cases where actual stoppage of work resulted, an appropriate time allowance was made. The heavy-land ploughing tests were carried out on wheat stubbles on Kimmeridge clay at Grange Farm, East Hanney, Berks. The light-land tests were carried out on stubbles and leys on a sandy loam soil at Manor Farm, Fyfield, Berks. Except in one or two instances, which are specially noted below, the remaining tests (maximum horse-power and drawbar pull) were carried out on the heavy-land site. Before the start of the tests each tractor was inspected and checked with the manufacturer's sales literature so as to ensure that it was a standard model in all respects.

The following commercial grades of fuel, supplied by Messrs. Shell-Mex and B.P. Ltd., were used throughout :—

Petrol: Commercial Spirit.
Vaporizing oil: Tractor Vaporizing oil.
Diesel fuel: Diesoline.

The results of the tests of maximum horse-power in ploughing and cultivating and of maximum drawbar pull are given, together with the results of the oil dilution analyses, in Table I.

The Results of the Ploughing Tests on heavy and light land respectively are given in Tables II. and III. In both tables regard should be paid to the values tabulated for the ratio of the actual horse-power to the maximum horse-power since,

particularly on the light land, some of the tractors were less fully loaded than others. In both tables there is given, in addition to the actual results recorded during the tests, a comparative estimate of the rate of ploughing and fuel consumption that each tractor should accomplish when working with a similar load under conditions representing the averages for all the plots on the two types of land respectively.

Spring Tests.

The following seven tractors are due to be tested in the Spring of 1938 :—

Caterpillar 22 Tracklaying Tractor.
Case Model CC4 Wheel Tractor.
Massey-Harris Challenger Wheel Tractor.
International F.20 Wheel Tractor.
Fordson Row-crop Tractor.
Ailsa Craig Roadless Tractor.
John Deere Model B Wheel Tractor.

S. J. Wright.

Institute for Research in Agricultural Engineering,
University of Oxford.

Royal Agricultural Society of England.

Established May 9th, 1838, *as the* English Agricultural Society, *and incorporated by Royal Charter on March 26th,* 1840.)

Patron.

HIS MOST GRACIOUS MAJESTY THE KING.

President for 1938.

THE EARL OF PLYMOUTH.

Year when first elected on Council	Trustees.
1930	H.R.H. The Duke of Gloucester, K.G., *York House, St. James's Palace, S.W.*1.
1935	H.R.H. The Duke of Kent, K.G., 3, *Belgrave Square, S.W.*1.
1905	Adeane, Charles, C.B., *Babraham Hall, Cambridge.*
1895	Bedford, Duke of, K.G., *Woburn Abbey, Bedfordshire.*
1921	Burrell, Sir Merrik R., Bt., C.B.E., *Floodgates, West Grinstead.*
1887	Crutchley, Percy, *Sunninghill Lodge, Ascot, Berkshire.*
1904	Daresbury, Lord, C.V.O., *Walton Hall, Warrington.*
1898	Devonshire, Duke of, K.G., *Chatsworth, Bakewell, Derbyshire.*
1910	Harlech, Lord, K.C.B., *Brogyntyn, Oswestry, Shropshire.*
1909	Hazlerigg, Sir Arthur, Bt., *Noseley Hall, Leicestershire.*
1922	Mildmay of Flete, Lord, *Flete, Ivybridge, Devon.*
1891	Stanyforth, Lt.-Col. E. W., C.B., *Kirk Hammerton Hall, York.*
	Vice-Presidents.
1918	Burke, U. Roland, *Edensor House, Bakewell, Derbyshire.*
1911	Courthope, Col. The Right Hon. Sir G. L., Bt., M.C., M.P., *Whiligh Sussex.*
1908	Derby, Earl of, K.G., *Knowsley, Prescot, Lancashire.*
1924	Desborough, Lord, K.G., *Taplow Court, Maidenhead.*
1913	Evens, John, *Burton, Lincoln.*
1900	Greaves, R. M., *Wern, Portmadoc, North Wales.*
1929	Harewood, Earl of, K.G., *Harewood House, Leeds.*
1903	Harrison, William, *Albion Iron Works, Leigh, Lancashire.*
1911-17 1926	Hastings, Lord, *Melton Constable Park, Norfolk.*
1915	Portland, Duke of, K.G., *Welbeck Abbey, Worksop, Notts.*
1914	Powis, Earl of, *Powis Castle, Welshpool, Mont.*
1934	Stradbroke, Earl of, K.C.M.G., *Henham Hall, Wangford, Beccles.*
	Ordinary Members of the Council.
1936	Aldersey, Capt. Ralph, *Crooke Aldersey, Chester (Cheshire).*
1922	Alexander, Hubert, *The Croft, Sully, Penarth (Glamorgan).*
1937	Baird, Capt. W. J., *Deanscroft, Oakham, Rutland (Rutland).*
1931	Barclay, E. E., *Brent Pelham Hall, Buntingford (Hertfordshire).*
1937	Belcher, J. Morris, *Tibberton Manor, Wellington (Shropshire).*
1922	Bell, John, *The Hall, Thirsk, Yorks. (London).*
1930	Benyon, Henry A., *Englefield House, near Reading (Berkshire).*
1921-29 1935	*Bledisloe, Viscount, G.C.M.G., K.B.E., *Lydney Park, Glos.*
1936	Bourne, John, *Snowshill Hill, Moreton-in-Marsh (Gloucestershire).*
1934	Bruford, Robert, *Fons George House, Taunton (Somerset).*
1931	Burrell, Walter R., *Knepp Castle, Horsham (Sussex).*
1936	Cator, Capt. H. J., M.C., *Ranworth Hall, Norwich (Norfolk).*
1928	Christy, Capt. Hugh A., *Llangoed, Llyswen, Breconshire (S. Wales).*
1921	*Dampier, Sir W. C. D., Sc.D., F.R.S., *Upwater Lodge, Cambridge.*
1935	Digby, Lord, D.S.O., M.C., *Minterne, Dorchester (Dorset).*

* Nominated Member of Council.

Ordinary Members of the Council (*continued.*)

Year when first elected on Council	
1927	DUGDALE, Major W. MARSHALL, D.S.O., *Llwyn, Llanfyllin, Mont.* (*North Wales*).
1935	DYOTT, Major R. A., *The Manor of Freeford, Lichfield* (*Staffordshire*).
1936	EGERTON, Lt.-Commdr. H. SYDNEY, D.S.C., R.N., *Mountfield Court, Robertsbridge* (*Sussex*).
1929	ELGIN, Earl of, K.T., *Broomhall, Dunfermline* (*Scotland*).
1922	ELTISLEY, Lord, K.B.E., *Croxton Park, St. Neots* (*Huntingdonshire*).
1936	*EVANS, RICHARD H., *Barclay's Bank Chambers, Pwllheli.*
1936	EVERALL, WM., *Berwick Mount, Shrewsbury* (*Shropshire*).
1926	EVERARD, W. LINDSAY, M.P., *Ratcliffe Hall, Leicester* (*Leicestershire*).
1933	EVERETT, Major NORMAN, *Rushmere, Ipswich* (*Suffolk*).
1928	FORSHAW, THOMAS, *The Stud, Carlton-on-Trent, Newark* (*Notts*).
1935	FOSTER, Major GORDON B., *Leysthorpe, Oswaldkirk, York* (*Yorks., N. Riding*).
1922	GATES, B. J., *Pembury, Tring* (*Buckinghamshire*).
1916	GILBEY, Sir WALTER, Bt., *Elsenham Hall, Elsenham* (*Essex*).
1931	GLOSSOP, C. W. H., *Bramwith Hall, near Doncaster* (*Yorks., W. Riding*).
1925	HALE, WINDHAM E., *Mowbreck Hall, Kirkham* (*Lancashire*).
1925	HALL, J. HERBERT, *Hill House, Mobberley, Knutsford* (*Cheshire*).
1930	HANSFORD, Major C. C., *The Grove, Bristol*, 1 (*Gloucestershire*).
1905	HARRIS, JOSEPH, *Brackenburgh Tower, Penrith* (*Cumberland*).
1919	HOBBS, ROBERT, *Kelmscott, Lechlade, Glos.* (*Oxfordshire*).
1931	JERVOISE, Major F. H. T., *Herriard Park, Basingstoke* (*Hampshire*).
1923	JOHNSTONE, Capt. G. H., *Trewithen, Grampound Road* (*Cornwall*).
1932	KILPATRICK, JAMES, *Craigie Mains, Kilmarnock* (*Scotland*).
1928	MATTHEWS, R. BORLASE, *Greater Felcourt, East Grinstead* (*Surrey*).
1927	*NEAME, THOMAS, *The Offices, Macknade, Faversham.*
1932	*NICHOLSON, A. C., *Trent Ironworks, Newark, Notts.*
1930	QUESTED, J. EGERTON, *The Firs, Cheriton, Folkestone* (*Kent*).
1928	RADNOR, Earl of, *Longford Castle, Salisbury* (*Wiltshire*).
1924	*RANSOME, EDWARD C., *Highwood, Ipswich.*
1935	ROBERTSON, WILLIAM, *Stamford, Alnwick* (*Northumberland*).
1937	ROBINSON, J. C. E., F.S.I., 15A, *St. Paul's Square, Bedford* (*Bedfordshire*).
1927	*RUSSELL, Sir JOHN, D.Sc., F.R.S., *Rothamsted Experimental Station, Harpenden, Herts.*
1923	SAMPLE, C. H., 26, *St. Mary's Place, Newcastle-on-Tyne* (*Northumberland*).
1932	SCOTT, Capt. J. B., *Rotherfield Park, Alton* (*Hampshire*).
1931	SHELLEY, Sir JOHN F., Bt., *Shobrooke Park, Crediton* (*Devonshire*).
1930	SMITH, EUSTACE ABEL, *Longhills, Lincoln* (*Lincolnshire*).
1907	SMITH, FRED, *Deben Haugh, Woodbridge* (*Suffolk*).
1934	SMITH, WILLIAM, *The Leen, Pembridge, Leominster* (*Herefordshire*).
1933	STEDMAN, Sir L. FOSTER, *Machen House, Lower Machen, near Newport* (*Monmouthshire*).
1929	STRAFFORD, Earl of, *Wrotham Park, Barnet* (*Middlesex*).
1924	WAKEFIELD, JACOB, *Sedgwick House, Kendal* (*Westmorland*).
1933	WALKER, Sir IAN, Bt., *Osmaston Manor, Derby* (*Derbyshire*).
1933	WALKER, JOHN, *Knightwick Manor, Worcester* (*Worcestershire*).
1929	WEBB, S. OWEN, *Streetly Hall, West Wickham* (*Cambridgeshire*).
1925	WEIGALL, Lt.-Col. Sir ARCHIBALD G., K.C.M.G., *Englemere, Ascot* (*London*).
1936	WEIGHTMAN, ALBERT, *Middle Herrington Farm, Sunderland* (*Durham*).
1931	WHEATLEY, Col. C. J. H., *Berkswell Hall, Coventry* (*Warwickshire*).
1918	WICKHAM-BOYNTON, T. L., *Burton Agnes Hall, Driffield* (*Yorks., E. Riding*).

* Nominated Member of Council.

STANDING COMMITTEES.

*** Under Bye-Law 73, the President is a Member *ex officio* of all Committees, and the Trustees and Vice-Presidents are Members *ex officio* of all Standing Committees except the Committee of Selection and General Purposes.

Finance Committee.

Adeane, C. (*Chairman*)
Devonshire, Duke of
Radnor, Earl of
Daresbury, Lord
Burrell, Sir Merrik
Courthope, Sir G. L.
Hazlerigg, Sir A.
Bruford, R.
Burke, U. Roland
Crutchley, Percy
Greaves, R. M.
Hall, J. H.
Harrison, W.
Smith, E. A.
Wheatley, Col.

Journal and Education Committee.

Neame, T. (*Chairman*)
Elgin, Earl of
Radnor, Earl of
Mildmay of Flete, Lord
Burrell, Sir Merrik
Dampier, Sir W. C. D.
Hazlerigg, Sir A.
Russell, Sir John
Adeane, C.
Burke, U. Roland
Burrell, Walter R.
Dugdale, Major W. M.
Glossop, C. W. H.
Hansford, Major C. C.

Chemical Committee.

Gates, B. J. (*Chairman*)
Bledisloe, Viscount
Dampier, Sir W. C. D.
Russell, Sir John
Bruford, Robert
Everett, Major N.
Greaves, R. M.
Hale, W. E.
Jervoise, Major F. H. T.
Quested, J. E.
Robertson, W.
Sample, C. H.
Smith, Fred

Botanical and Zoological (Forestry and Orchards) Committee.

Hastings, Lord (*Chairman*)
Courthope, Sir G. L.
Hazlerigg, Sir A.
Benyon, H. A.
Bourne, John
Burke, U. Roland
Burrell, Walter R.
Christy, Capt. H. A.
Dugdale, Major W. M.
Gardner, R. C. B.
Hansford, Major C. C.
Jervoise, Major F. H. T.
Le Sueur, A. D. C.
Neame, T.
Stone, Cyril
Thompson, C. H.
Walker, John
Weetman, Col. W. C. C.

Veterinary Committee.

Burrell, Sir Merrik (*Chairman*)
Radnor, Earl of
Digby, Lord
Mildmay of Flete, Lord
Gilbey, Sir Walter
Shelley, Sir J. F.
Stedman, Sir L. F.
Walker, Sir Ian
Weigall, Sir A. G.
Barclay, E. E.
Bell, John
Burke, U. Roland
Burrell, Walter R.
Crutchley, Percy
Dugdale, Major W. M.
Foster, Major G. B.
Gates, B. J.
Glossop, C. W. H.
Harris, Joseph
Johnstone, Capt. G. H.
Quested, J. E.
Robertson, W.
Smith, Fred
Smith, William
Stanyforth, Lt.-Col.
Walker, John
Weightman, A.
Wheatley, Col.

Committee of Selection and General Purposes.

Daresbury, Lord
The President
Harlech, Lord
Mildmay of Flete, Lord
Courthope, Sir G. L.
Weigall, Sir A. G.
Crutchley, Percy

And the Chairman of each of the Standing Committees.

Research Committee.

Dampier, Sir W. C. D. (*Chairman*)
Radnor, Earl of
Bledisloe, Viscount
Hastings, Lord
Burrell, Sir Merrik
Russell, Sir John
Adeane, C.
Burke, U. Roland
Burrell, Walter R.
Cator, Capt. H. J.
Dugdale, Major W. M.
Dyott, Major R. A.
Hansford, Major C. C.
Matthews, R. B.
Neame, T.
Scott, Capt. J. B.
Smith, Fred
Wigan, Capt. D. G.

Stock Prizes Committee.

Evens, John (*Chairman*)
Daresbury, Lord
Digby, Lord
Burrell, Sir Merrik
Shelley, Sir J. F.
Stedman, Sir L. F.
Walker, Sir Ian
Weigall, Sir A. G.
Barclay, E. E.
Bell, John
Burke, U. Roland
Crutchley, Percy
Evans, R. H.
Everall, W.
Everard, W. L.
Everett, Major N.
Forshaw, T.
Foster, Major G. B.
Glossop, C. W. H.
Greaves, R. M.
Harris, Joseph
Hobbs, Robert
Kilpatrick, James
Quested, J. E.
Robertson, W.
Smith, Fred
Smith, William
Walker, John
Webb, S. Owen
Weightman, A.
Wickham-Boynton, T. L.
The Stewards of Live Stock

Judges Selection Committee.—*Same as Stock Prizes Committee.*

Implement Committee.

Stanyforth, Lt.-Col. E. W. (*Chairman*)
Courthope, Sir G. L.
Dampier, Sir W. C. D.
Stedman, Sir L. F.
Bruford, R.
Burke, U. Roland
Cator, Capt. H. J.
Crutchley, Percy
Dyott, Major R. A.
Evens, John
Everett, Major N.
Harrison, W.
Matthews, R. B.
Nicholson, A. C.
Ransome, E. C.
Robertson, W.
Sample, C. H.
Webb, S. Owen
The Steward of Implements

Showyard Works Committee.

Burke, U. Roland (*Chairman*)
Daresbury, Lord
Burrell, Sir Merrik
Hazlerigg, Sir A.
Stedman, Sir L. F.
Bell, John
Bourne, John
Bruford, R.
Burrell, Walter R.
Crutchley, Percy
Everett, Major N.
Hall, J. H.
Hansford, Major C. C.
Nicholson, A. C.
Sample, C. H.
Stanyforth, Lt.-Col.
Webb, S. Owen
Wheatley, Col.

Standing Committees.

Dairy and Produce Committee.

EVANS, RICHARD H. (*Chairman*)
BURRELL, Sir MERRIK
DAMPIER, Sir W. C. D.
WEIGALL, Sir A. G.
BURKE, U. ROLAND
CRUTCHLEY, PERCY
EVENS, JOHN
GLOSSOP, C. W. H.
GREAVES, R. M.
JOHNSTONE, Capt. G. H.
KAY, Dr. H. D.
SMITH, FRED

Horticultural Committee.

HAZLERIGG, Sir A. (*Chairman*)
DARESBURY, Lord
BURKE, U. ROLAND

Honorary Director of Show.—U. ROLAND BURKE.

Surveyor to Show.—CHARLES H. R. NAYLOR, *St. Mary's Chambers Queen Street, Derby.*

Society's Officers.

Secretary.—T. B. TURNER, 16 Bedford Square, London, W.C.1.

Editor of Journal.—Prof. J. A. SCOTT WATSON, *School of Rural Economy, Oxford.*

Consulting Chemist.—

*Consulting Veterinary Surgeon.—The Principal, Royal Veterinary College, Camden Town, London, N.W.*1.

Botanist.—Prof. Sir R. H. BIFFEN, F.R.S., *School of Agriculture, Cambridge.*

Zoologist.—CECIL WARBURTON, M.A., *School of Agriculture, Cambridge.*

Consulting Engineer.—S. J. WRIGHT, M.A., *Institute for Research in Agricultural Engineering,* 11 *Parks Road, Oxford.*

Publisher.—JOHN MURRAY, 50 *Albemarle Street, W.*1.

Solicitors.—GARRARD, WOLFE, GAZE & CLARKE, 18 *St. James's Place, S.W.*1.

Bankers.—WESTMINSTER BANK, LTD., 1 *St. James's Square, S.W.*1.

DISTRIBUTION OF GOVERNORS AND MEMBERS OF THE SOCIETY, AND OF ORDINARY MEMBERS OF THE COUNCIL.

Electoral District	Division.	Number of Governors and Members.	Number of Ordinary Members of Council	Ordinary Members of Council.
A.	Bedfordshire	53	1	J. C. E. Robinson.
	Cheshire	374	2	Capt. Ralph Aldersey; J. H. Hall.
	Cornwall	75	1	Capt. G. H. Johnstone.
	Derbyshire	227	1	Sir Ian Walker, Bart.
	Dorset	87	1	Col. Lord Digby.
	Hampshire and Channel Islands	292	2	Major F. H. T. Jervoise; Capt. J. B. Scott.
	Hertfordshire	165	1	E. E. Barclay.
	Lancashire and Isle of Man	253	1	Windham E. Hale.
	Middlesex	53	1	Earl of Strafford.
	Monmouthshire	72	1	Sir L. Foster Stedman.
	Norfolk	256	1	Capt. H. J. Cator
	Northamptonshire	157	1	
	Northumberland	226	2	William Robertson; C. H. Sample.
	Staffordshire	253	1	Major R. A. Dyott.
	Worcestershire	131	1	John Walker.
	Yorkshire, N.R.	194	1	Major Gordon B. Foster.
	Scotland	288	2	Earl of Elgin; James Kilpatrick.
		—3,156	— 21	
B.	Buckinghamshire	108	1	B. J. Gates.
	Devon	153	1	Sir J. F. Shelley, Bart.
	Durham	120	1	Albert Weightman.
	Essex	215	1	Sir Walter Gilbey, Bart.
	Herefordshire	134	1	William Smith.
	Leicestershire	159	1	W. Lindsay Everard.
	London	410	2	John Bell; Sir A. G. Weigall.
	Nottinghamshire	159	1	Thomas Forshaw.
	Rutland	40	1	Capt. W. J. Baird.
	Shropshire	338	2	J. Morris Belcher; William Everall
	Suffolk	286	2	Major Norman Everett; Fred Smith
	Surrey	188	1	R. Borlase Matthews.
	Wiltshire	147	1	Earl of Radnor.
	Yorkshire, W.R.	246	1	C. W. H. Glossop.
	South Wales	73	1	Capt. H. A. Christy
		—2,776	— 18	
C.	Berkshire	177	1	H. A. Benyon.
	Cambridgeshire	156	1	S. Owen Webb.
	Cumberland	122	1	Joseph Harris.
	Glamorgan	51	1	Hubert Alexander.
	Gloucestershire	303	2	John Bourne; Major C. C. Hansford.
	Huntingdonshire	28	1	Lord Eltisley.
	Kent	259	1	J. E. Quested.
	Lincolnshire	247	1	Eustace Abel Smith.
	Oxfordshire	154	1	Robert Hobbs.
	Somerset	180	1	Robert Bruford.
	Sussex	319	2	Walter R. Burrell; Lieut.-Comdr. H. S. Egerton.
	Warwickshire	247	1	Col. C. J. H. Wheatley.
	Westmorland	62	1	Jacob Wakefield.
	Yorkshire, E.R.	85	1	T. L. Wickham-Boynton.
	Ireland	58	1	
	North Wales	181	1	Major W. Marshall Dugdale.
		—2,629	— 18	
Foreign Countries		180		*Viscount Bledisloe. *Sir W. C. D. Dampier.
Members with no Addresses		18	7	*Richard H. Evans. *Thomas Neame.
Grand Totals		8,759	64	*A. C. Nicholson. *E. C. Ransome. *Sir John Russell.

* Nominated Members of Council.

TABLE SHOWING THE NUMBER OF GOVERNORS AND MEMBERS IN EACH YEAR FROM THE ESTABLISHMENT OF THE SOCIETY.

Year.	President of the Year.	Governors. Life.	Governors. Annual.	Members. Life.	Members. Annual.	Members. Honorary.	Total.
1839	3rd Earl Spencer	—	—	—	—	—	1,100
1840	5th Duke of Richmond	86	189	146	2,434	5	2,860
1841	Mr. Philip Pusey	91	219	231	4,047	7	4,595
1842	Mr. Henry Handley	101	211	328	5,194	15	5,849
1843	4th Earl of Hardwicke	94	209	429	6,155	15	6,902
1844	3rd Earl Spencer	95	214	442	6,161	15	6,927
1845	5th Duke of Richmond	94	198	527	5,899	15	6,733
1846	1st Viscount Portman	92	201	554	6,105	19	6,971
1847	6th Earl of Egmont	91	195	607	5,478	20	6,391
1848	2nd Earl of Yarborough	93	186	648	5,387	21	6,335
1849	3rd Earl of Chichester	89	178	582	4,643	20	5,512
1850	4th Marquis of Downshire	90	169	627	4,356	19	5,261
1851	5th Duke of Richmond	91	162	674	4,175	19	5,121
1852	2nd Earl of Ducie	93	156	711	4,002	19	4,981
1853	2nd Lord Ashburton	90	147	739	3,928	19	4,923
1854	Mr. Philip Pusey	88	146	771	4,152	20	5,177
1855	Mr. William Miles, M.P.	89	141	795	3,838	19	4,882
1856	1st Viscount Portman	85	139	839	3,896	20	4,979
1857	Viscount Ossington	83	137	896	3,933	19	5,068
1858	6th Lord Berners	81	133	904	4,010	18	5,146
1859	7th Duke of Marlborough	78	130	927	4,008	18	5,161
1860	5th Lord Walsingham	72	119	927	4,047	18	5,183
1861	3rd Earl of Powis	84	90	1,113	3,328	18	4,633
1862	H.R.H. The Prince Consort / 1st Viscount Portman	83	97	1,151	3,475	17	4,823
1863	Viscount Eversley	80	88	1,263	3,735	17	5,183
1864	2nd Lord Feversham	78	45	1,343	4,013	17	5,496
1865	Sir E. C. Kerrison, Bart., M.P.	79	81	1,386	4,190	16	5,752
1866	1st Lord Tredegar	79	84	1,395	4,049	15	5,622
1867	Mr. H. S. Thompson	77	82	1,388	3,903	15	5,465
1868	6th Duke of Richmond	75	74	1,409	3,888	15	5,461
1869	H.R.H. The Prince of Wales, K.G.	75	73	1,417	3,864	17	5,446
1870	7th Duke of Devonshire	74	74	1,511	3,764	15	5,436
1871	6th Lord Vernon	72	74	1,589	3,896	17	5,648
1872	Sir W. W. Wynn, Bart., M.P.	71	73	1,655	3,953	14	5,768
1873	3rd Earl Cathcart	74	62	1,832	3,936	12	5,916
1874	Mr. Edward Holland	76	58	1,944	3,756	12	5,846
1875	1st Viscount Bridport	79	79	2,058	3,918	11	6,145
1876	2nd Lord Chesham	83	78	2,164	4,013	11	6,349
1877	Lord Skelmersdale	81	76	2,239	4,073	17	6,486
1878	Col. Kingscote, C.B., M.P.	81	72	2,328	4,130	26	6,637
1879	H.R.H. The Prince of Wales, K.G.	81	72	2,453	4,700	26	7,332
1880	9th Duke of Bedford	83	70	2,673	5,083	20	7,929
1881	Mr. William Wells	85	69	2,765	5,041	19	7,979
1882	Mr. John Dent Dent	82	71	2,849	5,059	19	8,080
1883	6th Duke of Richmond and Gordon	78	71	2,979	4,952	19	8,099
1884	Sir Brandreth Gibbs	72	72	3,203	5,408	21	8,776
1885	Sir Massey Lopes, Bart., M.P.	71	69	3,356	5,619	20	9,135
1886	H.R.H. The Prince of Wales, K.G.	70	61	3,414	5,569	20	9,134
1887	2nd Lord Egerton of Tatton	71	64	3,440	5,387	20	8,982
1888	Sir M. W. Ridley, Bart., M.P.	66	56	3,521	5,225	16	8,884
1889	HER MAJESTY QUEEN VICTORIA	73	58	3,567	7,153	15	10,866
1890	Lord Moreton	122	58	3,846	6,941	17	10,984
1891	2nd Earl of Ravensworth	117	60	3,811	6,921	19	10,928
1892	1st Earl of Feversham	111	69	3,784	7,066	20	11,050
1893	1st Duke of Westminster, K.G.	107	74	3,786	7,138	21	11,126
1894	8th Duke of Devonshire, K.G.	113	73	3,798	7,212	22	11,218
1895	Sir J. H. Thorold, Bart.	120	80	3,747	7,179	23	11,149
1896	Sir Walter Gilbey, Bart.	126	83	3,695	7,253	23	11,180
1897	H.R.H. The Duke of York, K.G.	126	83	3,705	7,285	24	11,223
1898	5th Earl Spencer, K.G.	121	79	3,687	7,182	25	11,094
1899	9th Earl of Coventry	116	75	3,656	7,009	23	10,879
1900	H.R.H. The Prince of Wales, K.G.	111	71	3,628	6,832	24	10,666
1901	3rd Earl Cawdor	102	70	3,564	6,338	27	10,033
1902	H.R.H. Prince Christian, K.G.	100	69	3,500	5,955	26	9,650
1903	H.R.H. The Prince of Wales, K.G.	99	62	3,439	5,771	27	9,398
1904	16th Earl of Derby, K.G.	96	68	3,375	5,906	32	9,477

TABLE SHOWING THE NUMBER OF GOVERNORS AND MEMBERS IN EACH YEAR FROM THE ESTABLISHMENT OF THE SOCIETY—*contd.*

Year.	President of the Year.	Governors		Members.			Total.
		Life.	Annual.	Life.	Annual.	Honorary.	
1905	9th Lord Middleton	89	78	3,212	5,758	33	9,170
1906	Mr. F. S. W. Cornwallis	94	155	3,132	6,189	30	9,600
1907	4th Earl of Yarborough	91	174	3,076	6,299	29	9,669
1908	Duke of Devonshire, K.G.	89	178	3,019	6,442	30	9,758
1909	7th Earl of Jersey, G.C.B.	91	177	2,951	6,696	31	9,946
1910	Sir Gilbert Greenall, Bart.	86	166	2,878	6,934	31	10,095
1911	HIS MAJESTY KING GEORGE V.	85	168	2,805	7,191	30	10,279
1912	9th Lord Middleton	85	170	2,741	7,283	30	10,309
1913	2nd Earl of Northbrook	89	168	2,691	7,474	26	10,448
1914	Earl of Powis	89	173	2,626	7,629	28	10,545
1915	Duke of Portland, K.G.	88	184	2,517	7,313	28	10,130
1916	7th Duke of Richmond and Gordon, [K.G.	83	185	2,427	7,526	27	10,248
1917	Mr. Charles Adeane, C.B.	93	210	2,412	8,214	26	10,955
1918	Hon. Cecil T. Parker	102	224	2,395	8,226	25	10,972
1919	Sir J. B. Bowen-Jones, Bart.	119	236	2,411	8,558	24	11,348
1920	H.R.H. The Prince of Wales, K.G.	129	256	2,402	9,208	25	12,020
1921	Mr. R. M. Greaves	137	275	2,374	10,098	24	12,908
1922	H.R.H. The Duke of York, K.G.	144	287	2,317	10,596	22	13,366
1923	Lt.-Col. E. W. Stanyforth	153	293	2,262	10,778	20	13,506
1924	Mr. Ernest Mathews, C.V.O.	159	289	2,201	10,676	21	13,346
1925	Sir Gilbert Greenall, Bart, C.V.O.	158	291	2,160	10,949	15	13,573
1926	Lord Desborough, G.C.V.O.	155	276	2,103	10,251	15	12,800
1927	1st Viscount Tredegar, C.B E.	153	257	2,035	9,343	15	11,803
1928	Lord Harlech, C.B.	155	277	1,972	9,042	16	11,462
1929	Earl of Harewood, K.G.	154	273	1,914	8,813	16	11,170
1930	H.R.H. The Duke of Gloucester, K.G.	158	264	1,882	8,491	16	10,811
1931	Sir Arthur Hazlerigg, Bart.	153	245	1,823	8,036	16	10,273
1932	Lord Mildmay of Flete	144	223	1,774	7,501	13	9,655
1933	Duke of Devonshire, K.G.	140	212	1,707	7,367	13	9,439
1934	Earl of Stradbroke, K.C.M.G.	140	205	1,666	7,141	17	9,169
1935	H.R.H. The Duke of Kent, K.G.	142	201	1,614	7,029	18	9,004
1936	Sir Merrik R. Burrell, Bt., C.B.E.	140	196	1,588	7,027	17	8,968
1937	Mr. U. Roland Burke.	135	195	1,560	6,854	15	8,759

STATEMENT made to the Council by the Chairman of the Finance Committee, on presenting the Accounts for the year 1936.

Mr. Adeane said the Accounts were set out in considerable detail and were in the hands of members, so that he did not think he need detain the Council at any great length. The Society began the year 1936 with a balance of £3,579; the receipts for the year amounted to £19,114, giving a total of £22,693. On the expenditure side the total payments amounted to £19,670. The balance carried forward at the end of the year was £3,023.

With regard to the Balance Sheet, there had again been a slight depreciation in the market value of the investments. At the end of the year that depreciation amounted to £2,134. The new money invested during the year was £5,000; of this sum £1,667 was subsequently realized to meet the loss on the Bristol Show. The Reserve Fund investments now stood at £237,490, compared with £236,292 at 31st December, 1935, an increase of £1,198. That the increase was so small was due to the depreciation in the market value of the investments and the loss on the Bristol Show. The Council would be glad to know that the sum of £3,000 originally paid in connection with the purchase of the lease of 16, Bedford Square, which ran until 1951, had now been written off.

With regard to the Estimates for 1937, the total receipts were estimated at £18,387, and the total expenditure at £18,128. The only item to notice was the increase under the head of Salaries. This was mainly due to the appointment of two new members of the staff. In view of the tractor trials to be held at Oxford this year, the sum of £300 had been provided to meet the expenditure.

Figures for 1935 £	Receipts.	£ s. d.	£ s. d.	£ s. d.
	CASH AT BANKERS AND IN HAND, JANUARY 1, 1936 :—			
44	Reserve Fund Account		148 0 0	
3,200	Current Account		3,241 2 11	
210	Petty Cash at Bank and in Hand		190 0 6	
3,454				3,579 3 5
	SUBSCRIPTIONS :—			
1,139	Annual Governors	1,101 0 0		
7,157	Annual Members	7,196 4 3		
42	Life Governors and Members	30 7 0		
69	For previous years	79 10 9		
8,407			8,407 2 0	
	JOURNAL OF THE SOCIETY :—			
257	Advertisements	240 19 11		
123	Sales and Reprints	111 6 0		
380			352 5 11	
	EXAMINATIONS :—			
517	National Diploma in Agriculture	567 14 0		
357	National Diploma in Dairying	414 7 7		
874			982 1 7	
	MISCELLANEOUS :—			
7,160	Interest on Investments	7,335 9 7		
357	Income Tax refunded	446 6 10		
50	Bank Interest	41 7 8		
22	Sales of Pamphlets, etc.	28 12 4		
135	Sales of Text Book	178 3 8		
37	Hire of Rooms	30 9 0		
106	Donations to Society's Funds	109 13 2		
100	Argentine Rural Society	250 0 0		
136	Park Royal Drainage Rate	105 3 3		
256	Rent, 12, Hanover Square	255 15 0		
8,359			8,781 0 6	
18,020	TOTAL OF ORDINARY RECEIPTS			18,522 10 3
548	Life Compositions of Governors and Members		478 0 0	
135	Subscriptions for 1937		99 11 0	
100	*Legacy for research re Foot and Mouth Disease*		—	
1	Show Account : Postage, Dec., 1935		2 4 3	
—	„ „ Prize Fund Interest		6 0 6	
—	Sales of Show Plant		5 5 6	
30	*Argentine Rural Society*		—	
814				591 1 0
£22,288				£22,692 14 8

Payments.	£	s.	d.	£	s.	d.	£	s.	d.
GENERAL ADMINISTRATION :—									
Salaries and Wages	4,085	15	11						
Pensions	474	18	11						
Legal Charges, Auditors' Fees, etc.	422	16	11						
Rent, Rates, and House Expenses	997	12	2						
Printing and Stationery	381	16	7						
Postage, Telephone and Sundries	398	11	10						
				6,761	12	4			
JOURNAL OF THE SOCIETY :—									
Volume 96	1,421	17	6						
Re Volume 97, etc.	47	16	10						
				1,469	14	4			
SCIENTIFIC DEPARTMENTS :—									
Chemist's Salary and Petty Cash	409	4	1						
Botanist's Salary	250	0	0						
Zoologist's Salary	200	0	0						
Grant to Royal Veterinary College	400	0	0						
Grant to Research Institute, Reading	50	0	0						
Medal *re* Cattle Pathology	2	13	2						
				1,311	17	3			
EXAMINATIONS :—									
National Diploma in Agriculture	619	12	3						
National Diploma in Dairying	409	18	9						
				1,029	11	0			
MISCELLANEOUS :—									
Grant to Research Fund	1,945	0	0						
Library : Books, etc.	28	4	0						
Repairs, etc., to House and Furniture	37	0	7						
Medals, etc., for Long Service	10	6	6						
"Elements of Agriculture," new edition	450	0	9						
Cleaning and Lighting Picture	49	5	0						
Grant to Mrs. C. Blair	50	0	0						
Donation to R.A.B.I. and another	—								
Donation to Royal Veterinary College rebuilding, etc., Fund	500	0	0						
Grant *re* Education Exhibit, Bristol Show	75	0	0						
,, to Grassland Congress	50	0	0						
Governors' Ladies' Badges	43	15	0						
Gold Medal	23	6	0						
Argentine Rural Society	250	0	0						
Park Royal Drainage Rate	227	6	0						
Rent, 12, Hanover Square	255	15	0						
Amount set aside towards Loss on Shows (of this sum £1,667 9*s.* 5*d.* met loss on Bristol Show)	3,500	0	0						
				7,494	18	10			
TOTAL OF ORDINARY PAYMENTS							18,067	13	9
Agricultural Research Council: Legacy:				—					
Show Account : Postage, Dec., 1936				1	14	3			
Investment Account				1,498	4	9			
Additions to Fittings				12	0	0			
,, ,, Show Plant				60	8	0			
Argentine Rural Society				30	0	0			
							1,602	7	0
CASH AT BANKERS AND IN HAND, DECEMBER 31, 1936 :—									
Reserve Fund Account				418	0	0			
Current Account				2,421	1	1			
Petty Cash at Bank and in Hand				183	12	10			
							3,022	13	11
							£22,692	14	8

BALANCE SHEET,

Figures for 1935 £		£ s. d.	£ s. d.	£ s. d.
	CAPITAL AND RESERVE FUND—			
239,554	As at December 31, 1935 . .		243,886 15 3	
	SHOW FUND—			
	Contribution from Ord'nary Account			
3,500	to Show Fund	3,500 0 0		
(*Add*) 6,506	*Less*: Loss on Bristol Show .	1,667 9 5		
(*Less*) 1,950	*Grant to Local Committee* . .	—		
8,056			1,832 10 7	
247,610			245,719 5 10	
	RECEIPTS AND PAYMENTS ACCOUNT—			
	Ordinary Receipts . . .	18,522 10 0		
	Ordinary Payments . . .	18,067 13 9		
1,128			454 16 3	
548	Life Compositions received in 1936		478 0 0	
117	Subscriptions in advance received in 1935		134 12 0	
249,403			246,786 14 1	
5,378	*Less*: Depreciation in market values of Investments . . .		2,134 5 9	
244,025			244,652 8 4	
(*Add*) 217	*Less*: Adjustment *re* outstanding Assets and Liabilities . . .		254 2 2	
244,242			244,398 6 2	
	DEPRECIATION written off, viz. :—			
35	Furniture, Fittings, etc. . .	32 6 8		
221	Show Plant	204 9 3		
100	Lease of 16, Bedford Square . .	100 0 0		
356			336 15 11	
243,886				244,061 10 3
	SUNDRY CREDITORS—			
2,025	Sundry Accounts owing . . .		3,676 8 11	
135	Subscriptions for 1937 received in 1936		99 11 0	
2,160				3,775 19 11
£246,046				£247,837 10 2

NOTE—There are commitments in respect of Contracts entered into in connexion with the forthcoming Show.

T. B. TURNER,
Secretary.

Having examined the foregoing Statement of Receipts and Payments and Balance Sheet with the books sets forth the cash transactions of the Society for the year 1936 and that the Balance Sheet sets forth Investments were at the close of the year duly inscribed in the name of the Society or of Trustees on its Society's Bankers.

DECEMBER 31, 1936.

Figures for 1935.		£ s. d.	£ s. d.
	RESERVE FUND INVESTMENTS AT MARKET PRICES ON DECEMBER 31, 1936:—		
166,591	£154,609 4s. 11d. Conversion Loan 3½% (1961 or after) @ 106⅜	164,465 11 9	
3,773	£3,909 16s. 0d. *Local Loans* 3% (1912)	—	
2,997	£2,840 13s. 6d. Metropolitan 3% Consolidated Stock (1941) @ 104¼	2,961 8 0	
6,789	£6,528 1s. 6d. Dominion of Canada 4% Stock (1940–60) @ 105	6,854 9 6	
2,752	£2,724 11s. 7d. Metropolitan Water 3% (E) Stock (1953–73) @ 101	2,751 16 6	
13,336	£12,234 12s. 5d. Commonwealth of Australia 4% Stock (1955–70) @ 109	13,335 14 9	
7,277	£6,800 14s. 2d. Union of S. Africa 3½% Stock (1953–73) @ 106	7,208 15 0	
7,215	£6,500 Dominion of Canada 4% Stock (1953–58) @ 113	7,345 0 0	
11,827	£11,371 18s. Commonwealth of Australia 3¾% Stock (1946–49) @ 104	11,826 15 6	
3,601	£3,430 Central Electricity Board 3½% Stock (1963–93) @ 103	3,532 18 0	
5,097	£4,719 London, Midland & Scottish Rly. Co. 4% Debenture Stock @ 107½	5,072 18 6	
5,037	£4,914 2s. 8d. Funding Loan 3% (1959–69) @ 101⅜	4,981 14 0	
—	£3,784 9s. 10d. Croydon Corporation 3% Stock (1956–8) @ 101	3,822 6 9	
—	£3,416 8s. 4d. Railway Finance Corporation 2½% Guaranteed Debenture Stock (1951–2) @ 97½	3,331 0 0	237,490 8 3
236,292			
	LEASE OF 16 BEDFORD SQUARE	100 0 0	
100	*Less* Amount written off in 1936	100 0 0	—
	FURNITURE, FITTINGS, FIXTURES, ETC.—		
	As at December 31, 1935	311 6 1	
	Added during 1936	12 0 0	
		323 6 1	
311	*Less* Depreciation @ 10%	32 6 8	290 19 5
1,500	PICTURES (£500) and BOOKS (£1,000)		1,500 0 0
	SHOW PLANT—		
	As at December 31, 1935	1,989 10 4	
	Net additions during 1936	55 2 6	
		2,044 12 10	
1,990	*Less* Depreciation @ 10%	204 9 3	1,840 3 7
1,545	EXPENDITURE (less amounts received) *re* WOLVERHAMPTON SHOW		1,082 8 11
403	SUNDRY DEBTORS		322 16 10
309	RATES PAID IN ADVANCE AND INCOME TAX RECOVERABLE		334 3 8
	CASH AT BANKERS AND IN HAND—		
148	Reserve Fund Account	418 0 0	
2	*Investment Account*	—	
3,241	Current Account	2,421 1 1	
190	Petty Cash at Bank and in Hand	183 12 10	
3,581		3,022 13 11	
15	Show Account	1,953 15 7	4,976 9 6
3,596			
£246,046			£247,837 10 2

…nd vouchers of the Society, we report to the Members of the Society that in our opinion the Statement truly …orrectly its financial position on the 31st December, 1936. We have satisfied ourselves that the Society's …ehalf or, where the stocks are registered, that the certificates of title were then in the possession of the

Royal Agricultural Society of England.

STATEMENTS OF FUNDS HELD BY THE SOCIETY IN TRUST OR WHICH ARE NOT CONSIDERED AVAILABLE FOR GENERAL PURPOSES, DECEMBER 31, 1936.

E. H. HILLS' BEQUEST.

	£ s. d.	£ s. d.		£ s. d.
To amount bequeathed for Pot-culture Experiments		9,000 0 0	By £7,222 15*s.* 0*d.* 3½% Conversion Loan Stock (1961) (purchased on sale of War Loan Stock) at cost . . . . (*Value December* 31, 1936, at 106⅜ = £7,683 4*s.* 0*d.*)	5,616 1 10
Less: Depreciation of Consols at time of conversion .	3,582 7 11			
„ Cost of conversion . .	134 14 7			
		3,717 2 6		
		5,282 17 6		
To surplus on sale of 5% War Loan Stock . .		333 4 4		
		£5,616 1 10		£5,616 1 10

QUEEN VICTORIA GIFTS FUND.

	£ s. d.		£ s. d.
To Fund originally invested (the income from this Fund is used to make Annual Grants to unsuccessful applicants for pension through the Royal Agricultural Benevolent Institution) .	5,000 0 0	By Investments in names of Trustees: at cost:	
Less: Loss on sales of stocks	110 18 0	£1,045 19*s.* 3*d.* Dominion of Canada 3½% Registered Stock, 1950–55	1,017 7 0
		£2,046 11*s.* 8*d.* Commonwealth of Australia 3½% Registered Stock, 1954–59	2,099 18 10
	4,889 2 0	£1,000 London Midland & Scottish Railway Consolidated 4% Guaranteed Stock . . .	1,556 15 9
Undistributed income	97 14 10	£190 4*s.* 6*d.* 2½% Consols	215 0 5
			4,889 2 0
		By Cash at Bank, December 31, 1936 . . .	97 14 10
	£4,986 16 10		£4,986 16 10

The market values of the Stocks on December 31, 1936, amounted to £4,411 10*s.* 5*d.*

STATEMENTS OF FUNDS HELD BY THE SOCIETY IN TRUST—*continued.*

Gilbey Fund.

	£ s. d.		£ s. d.
To Amount provided by the late Sir Walter Gilbey for endowment of Lectureship at Cambridge University	1,000 0 0	By Investment at cost :— £1,457 5*s*. 2*d*. Metropolitan Water " A " Stock (*Value on December* 31, 1936, at 99=£1,442 13*s*. 9*d*.)	1,204 10 4
Accumulation of Interest	204 10 4		
	£1,204 10 4		£1,204 10 4

Superannuation and Insurance Fund.

	£ s. d.	£ s. d.		£ s. d.
To amount set aside in accordance with declaration of Trust of July 26, 1911		9,171 5 0	By Investments in names of Trustees, at cost :— £9,028 0*s*. 7*d*. 3½% War Loan Stock (1952) (converted from 5% Stock, July, 1932.)	8,453 7 8
Less : Depreciation and cost of conversion of Consols		2,094 1 4	£827 4*s*. 4*d*. West Australian 3½% Inscribed Stock (1935–55)	659 17 4
		7,077 3 8	£794 6*s*. 1*d*. Queensland 3½% Inscribed Stock (1950–70)	620 0 9
Purchase of 5% War Loan		1,167 0 0		9,733 5 9
Accumulation to Dec. 31, 1935		1,755 11 8	By Cash at Bank, December 31, 1936	426 18 3
		9,999 15 4		
Income for 1936	358 12 0		(Note.—The market values of the Stocks on Dec. 31, 1936, amounted to £11,154 7*s*. 3*d*.)	
Contribution from Society	362 8 11			
	721 0 11			
Less : Premiums, Income Tax and Pension	635 18 0			
		85 2 11		
		10,084 18 3		
Income Tax payable on War Stock Interest		75 5 9		
		£10,160 4 0		£10,160 4 0

" Merchants of the Staple of England " Fund.

	£ s. d.		£ s. d.
To capital sum paid by the " Merchants of the Staple of England " for the purpose of providing out of the yearly income Prizes to be competed for annually in the Wool Section of the Royal Show	500 0 0	By Investment at cost :— £526 11*s*. Commonwealth of Australia 3% Registered Stock, 1955–58	522 12 9
To bonus on Conversion of original Stock	22 12 9	Market value of Stock on Dec. 31/36, @ 97 = £510 15*s*. 1*d*.	
	£522 12 9		

Having examined the above Statements of Trust Funds with the books and vouchers of the Society, we report to the Members of the Society that in our opinion the Statements truly set forth the transactions relating to these Funds during the year 1936, and the state of the Funds at the close of the year. We have satisfied ourselves that the Investments set forth were duly inscribed at the close of the year in the names of the Trustees or, where the stocks are registered, that the certificates of title were then in the possession of the Society's bankers.

3, Frederick's Place,
Old Jewry, London, E.C. 2.

PRICE, WATERHOUSE & CO.,
Chartered Accountants,

Royal Agricultural Society of England.

RESEARCH COMMITTEE.

RECEIPTS AND PAYMENTS FOR YEAR 1936.

Receipts.	£	s.	d.	Payments.	£	s.	d.
To Grant from General Account	1,945	0	0	By Grants to Research Institute in Animal Pathology, Royal Veterinary College, for Research on Calf Diseases	300	0	0
				,, Grants to Rothamsted Experimental Station for:—			
				Lucerne Seed Inoculation Experiments	50	0	0
				Electricity on the Farm Investigation	200	0	0
				Cake Feeding on Grassland experiments	250	0	0
				,, Grant to Norfolk Agricultural Station for Experiments *re* disposal of Beet Tops and Straw	300	0	0
				,, Grant to Welsh Plant Breeding Station *re* Grass Seeds Mixture Trials	300	0	0
				,, Grant to Cambridge University Farm *re* Pig Feeding Experiments	75	0	0
				,, Grant to Armstrong College *re* Tick Eradication from Sheep Grazings	100	0	0
				,, Editing, etc.	20	0	0
				,, *Farmer's Guide to Agricultural Research in* 1935 :—			
				Honoraria to Contributors	350	0	0
	£1,945	0	0		£1,945	0	0

Examined, audited and found correct,

PRICE, WATERHOUSE & CO.,

Chartered Accountants,

Accountants and Auditors.

3, Frederick's Place,

Old Jewry, London, E.C. 2.

23rd February, 1937.

STATEMENT made to the Council by the Chairman of the Finance Committee, on presenting the Accounts of the Wolverhampton Show, 1937.

Mr. Adeane moved the adoption of the paragraph in the Report of the Finance Committee dealing with the Show accounts. The surplus at the Wolverhampton Show, which had been a great success was, he said, £680, and would have been greater but for the bad weather during the last two days of the Show. This gain compared with a loss of £2,175 when the Society visited Wolverhampton in 1871. The receipts, at £44,333 showed an increase of £2,638 as compared with Bristol. The most important additions were under the head of Implements, Sale of Catalogues and Admissions to the Showyard. The expenditure amounted to £43,653, a small increase over Bristol.

It was usual when making the report on the Show to express the thanks of the Council to those who had contributed to its success. The visit of Their Royal Highnesses the Duke and Duchess of Gloucester was not only an encouragement to the Society, but drew, as a Royal Visit always did, a great company to the Show. The Society received a warm welcome and generous support from Wolverhampton, and thanks were especially due to Lord Wrottesley, who very kindly placed at their disposal a portion of his park as a site for the Showyard ; to Sir Charles Mander, the Mayor of Wolverhampton ; and to the Local Committee for their invaluable help in connection with the local fund and local organization for the Show. The success of the Show was greatly due to Sir Charles Mander's assistance. It was difficult to express adequately the thanks of the Society to Mr. Burke, who had been during the year both President of the Society and Honorary Director of the Show, a heavy load to carry. (Applause.) Mr. Burke had done so to the complete satisfaction of everyone, and the smooth and efficient working not only of the Show but of all the operations of the Society were due to his courtesy, care and able administration during the past year. Mr. Burke would most certainly like the Council to associate with those efforts an acknowledgement of the services rendered by its Secretary, Mr. Turner, and the staff. (Applause.)

The paragraph was adopted.

STATEMENT OF RECEIPTS AND EXPENDI-

JULY 6 to

Figures for 1936 Show £	Receipts	£ s. d.	£ s. d.
2,000	Contribution from Wolverhampton Local Committee to Show Fund. .		2,000 0 0
	CONTRIBUTIONS TO PRIZE FUND :—		
2,078	Agricultural and Breed Societies and others	2,225 3 2	
—	Wolverhampton Local Committee .	68 0 0	
2,078			2,293 3 2
100	*Special Donation to Show* . . .		- - -
11,015	FEES FOR IMPLEMENTS, MACHINES AND MISCELLANEOUS EXHIBITS . .		11,867 0 10
	FEES FOR ENTRY OF LIVE STOCK :—		
6,578	Members	6,687 7 0	
849	Non-members	626 10 0	
7,427			7,313 17 0
182	FEES FOR ENTRY OF POULTRY AND EGGS		171 5 0
	OTHER ENTRY FEES :—		
144	Produce	102 19 0	
156	Horse-jumping Competitions . .	160 0 0	
31	Plantations Competition . . .	13 11 0	
47	Butter-making Competitions . .	38 15 0	
378			315 5 0
	CATALOGUE :—		
774	Advertising in Catalogue and extra lines	853 11 3	
731	Sales of Catalogue	926 7 8	
48	Sales of Daily Programmes . .	41 6 9	
1,553			1,821 5 8
	ADMISSIONS TO SHOWYARD :—		
989	Tuesday, July 6, @ 5*s*.	1,054 10 0	
2,899	Wednesday, July 7, @ 5*s*. and 3*s*. .	4,088 10 5	
2,814	Thursday, July 8, @ 3*s*. . . .	4,148 17 8	
2,053	Friday, July 9, @ 2*s*. 6*d*. . . .	1,225 11 2	
780	Saturday, July 10, @ 1*s*. . . .	616 19 3	
186	Season Tickets	183 14 6	
804	Day and other Tickets . . .	749 7 11	
10,525			12,067 10 11
£35,258	Carried forward . .		£37,849 7 7

TURE OF THE SHOW AT WOLVERHAMPTON, JULY 10, 1937.

Figures for 1936 Show £	Expenditure	£ s. d.	£ s. d.
	COST OF ERECTION AND MAINTENANCE OF SHOWYARD :—		
3,483	Transferring Society's permanent buildings from Bristol and re-erecting at Wolverhampton	2,342 5 3	
312	Fencing round Showyard	560 5 8	
1,753	Implement Shedding	2,160 7 0	
5,436	Stock Shedding and Sleeping Boxes	6,589 17 8	
2,838	Grand Stand, Offices, Rings, Signs, etc.	2,668 18 7	
1,222	General Labour, Horse and Motor Hire	1,368 14 1	
112	Hire of Sleepers	229 14 4	
2,177	Hire of Canvas	1,820 8 1	
621	*Excavating Post Holes*	– – –	
			17,740 10 8
17,954			
	SURVEYOR :—		
740	Salary, Travelling and Sundry Expenses	738 10 0	
252	Clerk of Works : Salary, Travelling, etc.	299 1 3	
			1,037 11 3
992			
	PRINTING :—		
593	General Printing, Prize Sheet, Tickets, etc.	656 13 11	
1,079	Catalogue, Award Lists and Jumping Programmes	1,115 3 5	
			1,771 17 4
1,672			
	ADVERTISING :—		
790	Newspaper Advertising	910 1 10	
674	Billposting and Window Cards, etc.	347 4 4	
184	Advertisement Boards	109 11 5	
			1,366 17 7
1,648			
221	POSTAGE, CARRIAGE, ETC.		192 16 10
12,335	AMOUNT OF PRIZES AWARDED (including £2,293 3*s.* 2*d.* given by various Societies and others—per contra)		12,504 3 2
922	FORAGE FOR LIVE STOCK		927 6 4
530	JUDGES OF STOCK : FEES AND EXPENSES		550 5 9
£36,274	Carried forward		£36,091 8 11

Statement of Receipts and Expenditure

Figures for 1936 Show £	Receipts (contd.).	£	s.	d.	£	s.	d.
35,258	Brought forward . .				37,849	7	7
	ADMISSIONS TO GRAND STAND :—						
786	Reserved Seats.	908	15	3			
1,101	Unreserved Seats	1,022	18	6			
1,887					1,931	13	9
	MISCELLANEOUS RECEIPTS :—						
1,440	Admissions to Flower Show . .	989	3	5			
2,199	Motor Parks	2,667	6	0			
111	Rent for Railway Offices . . .	111	0	0			
400	Premium for Catering . . .	400	0	0			
50	Premium for Cloak Rooms . .	50	0	0			
50	Rent of space for Ministry of Agriculture	50	0	0			
144	Advertisements in Stock Prize Sheet .	130	1	7			
127	Sales of Produce at Dairy . .	135	9	9			
26	Bristol Show :—outstanding items .	9	4	0			
3	Sundry Receipts	10	9	6			
4,550					4,552	14	
£41,695					£44,333	15	7
1,667	*Debit Balance*				—	—	—
£43,362					£44,333	15	7

Examined, audited and found correct this 24th day of November, 1937.

T. B. TURNER, *Secretary.*

PRICE, WATERHOUSE & CO., *Chartered Accountants.*

OF THE SHOW AT WOLVERHAMPTON (*continued.*)

Figures for 1936 Show £	**Expenditure** (*contd.*).	£ s. d.	£ s. d.
36,274	Brought forward .		36,091 8 11
	GENERAL ADMINISTRATION :—		
223	*Honorary Director*:—Travelling, Entertaining, etc.	267 13 8	
293	*Stewards and Assistants:—Stock, Hospitality, Refreshments and Implements*: Personal and Railway Expenses .	293 18 1	
555	*Secretary and Staff*:—Travelling, Maintenance, etc..	522 0 5	
680	*General Management* :—Finance Stewards, Grand Stand Men, Turnstile Men, Bank Staff, £255 7*s.* 0*d.*; Catalogue Sellers, £111 7*s.* 4*d.*; Foremen and Yardmen, £214 18*s.* 4*d.*; Gatekeepers, £116 6*s.* 3*d.*; Commissionaires, £21 16*s.* 7*d.*	719 15 6	
124	*Veterinary Department* :—Inspectors .	126 9 8	
159	*Engineering Department* :—Consulting Engineer	178 17 8	
342	Police	397 10 4	
2,376			2,506 5 4
	GENERAL SHOWYARD AND MISCELLANEOUS EXPENSES :—		
1,239	*Dairy* :—Building, £522 14*s.* 6*d.*; Steward, Assistants and Staff, £287 2*s.* 5*d.*; Milk, £262 15*s.* 0*d.*; Utensils, £102 6*s.* 6*d.*; Engineers, £107 2*s.* 4*d.*; Miscellaneous, £100 9*s.* 3*d.*	1,382 10 0	
552	*Poultry and Produce* :—Buildings, £376 9*s.* 2*d.*; Miscellaneous, £188 4*s.* 4*d.*	564 13 6	
669	*Flower Show* :—Hire of Tents, etc., £498 1*s.* 8*d.*; Miscellaneous, £206 0*s.* 10*d.*	704 2 6	
22	*Motor Parks* :—Tents, Offices, etc. .	69 6 10	
86	Plantations Competition	49 14 2	
255	Forestry :—Tent and Miscellaneous .	257 3 1	
581	Military Display and Band . .	782 11 5	
322	Hire of Furniture	310 10 0	
276	Royal and Official Luncheons . .	121 8 1	
53	St. John Ambulance	54 5 0	
94	Insurance	95 10 9	
74	Medals and Expenses *re* Cups . .	89 6 0	
110	Badges and Rosettes	136 2 5	
65	New Implements:—Testing and Medals	78 2 7	
12	Bristol Show :—outstanding items .	6 12 0	
302	Sundry expenses	353 16 4	
4,712			5,055 14 8
£43,362			£43,653 8 11
—	Credit Balance		680 6 8
£43,362			£44,333 15 7

Proceedings at General Meeting of Governors and Members

HELD IN THE CONFERENCE TENT IN WOLVERHAMPTON SHOWYARD,

at 11.30 a.m., THURSDAY, JULY 8th, 1937,

MR. U. ROLAND BURKE (President) IN THE CHAIR.

The PRESIDENT said that before proceeding with the business that morning he felt that it would be only fitting that he should make some reference to the very sad loss which not only the Society but the whole country had sustained in the passing of Lord Ernle. During his long and useful life he gained distinction in many directions, more especially in literature on agriculture matters, among his writings being that historical work, "English Farming, Past and Present." As Agent-in-Chief for the Duke of Bedford he had had a long experience of land administration, and, during that critical period from 1916 to 1919 he had been President of the Board of Agriculture. Two years ago the Society's Gold Medal for distinguished service to agriculture had been conferred on him and he was made an honorary member of the Society.

It was impossible for him, the President said, to add to the tribute paid to Lord Ernle by the then President, H.R.H. The Duke of Kent, when presenting the Gold Medal, but all would agree that they had lost a learned and experienced agriculturist and a great friend. He was sure that the Meeting would wish him to convey to the relatives of Lord Ernle, in the name of the Society, their heartfelt regrets at his passing.

Members stood in silence for a moment as a tribute.

Continuing, the President said it was 66 years since the Society last visited Wolverhampton and, judging from what he had read about the meeting of 1871, the Show this year appeared to be taking place in much happier circumstances. The previous Wolverhampton Show was held on the Duke of Cleveland's racecourse, a low-lying area of land which was richly irrigated by the sewage of the town. He hoped he was not causing any embarrassment to the Medical Officer of Health, but apparently that was the case. It had never stopped raining before and during the Show, and he had read in a cutting from a newspaper of the time that people went so far as to pay men to carry them on their backs from one part of the Showyard to another. That sort of thing was not likely to take place this year.

They were extremely indebted to Lord Wrottesley for having placed that excellent site at the disposal of the Society. They had, of course, had many good sites in the past, but he thought that Wrottesley Park was one of the nicest, if not the nicest, they had ever had for the Royal Show.

Ever since the idea was first mooted that they should come to Wolverhampton, the present Mayor, Sir Charles Mander, and his predecessor, Councillor Whittaker, had done everything possible to pave the way for holding the Show there, and, although it would be embodied in a resolution to be submitted later, he would like to express his own and the Society's thanks to them and to everybody in Wolverhampton who had assisted to bring about this Show.

It was impossible for him to thank everyone by name, but he would like specially to mention Mr. Robinson, the Borough Engineer, who had helped very much with the preparation of the showground, where a great deal of work was necessary which could only be done by the Local Authority. Mr. Robinson had done everything that was possible. He also desired to express his thanks to the Press, particularly to the *Express* and *Star*. They had gone out of their way to provide publicity for the Show, and had worked with

their colleagues of various provincial papers over a wide area, including Birmingham, and had gone all out to keep the Show before the public for many months. If they had a big crowd at the Show it would be almost entirely due to the efforts the Press had made.

The President made a special appeal to the Governors and Members present to assist the Council in their efforts to increase the Membership of the Society, in which there had been a considerable drop during the last few years. He expressed the hope that every one of them would do all in his power to get new subscribers before next year, when the Show would be held in Cardiff, and the following year, which would be the Society's Centenary, and the Show would be held at Windsor. He trusted that by the time the Centenary came along the Membership would again be brought back to what it was in the year 1926.

Thanks to Mayor and Corporation and Local Committee.

Col. STANYFORTH said the duty had been entrusted to him of moving "That the best thanks of the Society are due and are hereby tendered to the Mayor and Corporation of Wolverhampton and the Local Committee for their cordial reception of the Society and their efforts to promote the success of the Show." In the ordinary course of events this motion would have been proposed by the Honorary Director, but the Honorary Director this year was also the President. (Applause). Nearly everything he had been going to say had already been said by the President, but of course Mr. Burke had far more knowledge than anyone else of the work of the Mayor and Corporation and Local Committee. Going about the country with the Show, the Society naturally came in contact with many Lord Mayors and Mayors, and to those who did not realise the responsibility placed on the Chief Magistrates and Corporations of the places visited he might say that it really depended upon them what degree of success resulted from the visit of the Show. He ventured to say that the Society had never met with more sympathy, hard work and help than in Wolverhampton, and they were very much indebted to Sir Charles Mander for his active interest during and before his term of office as Mayor. With the Corporation and Local Committee he had done everything possible to make the Show a success, and he thought they might congratulate him and congratulate themselves on arranging with the clerk of the weather for such fine weather as the Show had been favoured with up to the present. At an agricultural show that was most important. No one would visit an exhibition of that character in teeming rain. He wished to emphasise that this was no formal resolution but a sincere recognition of the real hard work which had been put in both before and during the Show. (Applause.)

Major C. C. HANSFORD had very great pleasure in seconding the motion which had been so very well put by Col. Stanyforth. He, the speaker, had had some experience of the work which fell to the lot of the Local Committee in connection with the Show at Bristol last year, where unfortunately they did not have such a satisfactory liaison with the clerk of the weather.

The resolution of thanks was passed unanimously.

The MAYOR OF WOLVERHAMPTON (Sir Charles Mander) said that Mr. Burke had made some derogatory remarks about their sewage disposal on the occasion of the Society's last visit, but he could assure them that since 1871, when the Show was last at Wolverhampton, times had greatly changed and the town now disposed of its sewage in a much more efficient manner than in those early days. He did not think they need fear that the Medical Officer of Health would take any exception to the reference which had been made. Wolverhampton was now in the forefront in matters of that kind.

Referring to Lord Wrottesley, he said that the opinion appeared to be commonly held that his Lordship was making a good thing out of the Show.

But they knew, and the Council knew, and he wished to say it publicly, that Lord Wrottesley had given the ground free and would not make one penny out of it; and that, he thought, should be the attitude of any large owner of land on which the Show took place in future.

Personally, his chief task had been the raising of the Local Fund for the preparation of the ground, putting the surface in order, subsequently restoring it to its pristine condition after the Show, and compensating the tenant. It had been a difficult matter to persuade manufacturers in the district that the Royal Show was going to do them any good, and to show a man who, for instance, made bicycle gearing that he would sell more; but he had not attempted to put that argument before them. What he had said to them was, that the Show came to their town, perhaps three times in a couple of centuries, and it was their duty to support the Show on its infrequent visits. It was part of the duty of everyone to support the premier show of England. It was rather on that basis that he had been able to collect more than £5,000. Those manufacturers had since said, "Let us hope that the Royal Show will come more frequently in future."

He was sure that the attendance up to the present and the attendance during the next two days would induce the Council to come again, not every year, but perhaps once in a generation. He was sure some successor of his would welcome a suggestion of a Wolverhampton Show in, say, 1970.

When he had first met Mr. Burke he had realized that he was a man that one could work with harmoniously and be proud to work for, and it was largely due to his encouragement that Wolverhampton Corporation and their staff had done so splendidly. In Mr. Robinson, the Borough Engineer, they had a man *par excellence* who was able to carry out the job. He also paid a tribute to the work put in by Mr. Margary, their Electrical Engineer, and Mr. McMillan, their Water Engineer. He would also like to thank Mr. Heckle, their Development Officer, who all through had been his right-hand man. The Town Clerk was Honorary Secretary and Mr. Heckle was designated Assistant Honorary Secretary. The whole of the work had fallen on his shoulders.

The drop in membership had been mentioned by the President. He himself was not yet a Member of the Society, but he now proposed to set an example by becoming an annual subscriber.

In conclusion, he wished to say that he very much appreciated the manner in which the resolution of thanks had been accorded by the Meeting.

Suggestions Invited.

The PRESIDENT, in accordance with time-honoured custom, enquired whether any Governor or Member had any remark to make or suggestion to offer for the consideration of the Council.

No one rose to take advantage of this invitation.

Thanks to President.

Major SEYMOUR MEAD said it was his privilege to propose a vote of thanks to Mr. Burke for his services in the Chair during the year. Everyone who had worked with Mr. Burke knew how much he had done to make the Wolverhampton Show a success. In this he had spared no effort, and they were all very much indebted to him.

Captain R. MACDONALD BUCHANAN seconded the motion, which was put to the Meeting and carried by acclamation.

Mr. BURKE acknowledged the resolution of thanks to him for what he had done to further the success of the Show. In return, he could only express his own thanks to everyone—to the Council, to the Stewards of the Show,

and all who had helped him in his duties. This year he was endeavouring to carry out the two-fold duty of President and Honorary Director. Before starting on this task he had been rather nervous as to how he would be able to do it, but everyone had been so kind that his work had been lightened. They had been favoured so far with fine weather and the Show had made a very good start. He hoped that the fine weather would continue for the rest of the week, but whatever the financial result might be, he felt confident that everything possible had been done by the Mayor of Wolverhampton and those associated with him for the success of the Show. It had given him much pleasure to accept the great honour, for it was one that did not fall to everyone.

Mr. Burke concluded by saying that he had that morning received a letter from an old friend of his who had watched his progress since he was a boy. This friend had sent his good wishes in a rhyme, the reading of which afforded much amusement to those present. In this, reference was made to Noah as the organiser of the first livestock show.

Proceedings at the Annual General Meeting of Governors and Members

HELD AT THE SOCIETY'S HOUSE, 16, BEDFORD SQUARE, LONDON, W.C. 1,

On WEDNESDAY, DECEMBER 8th, 1937, at 12 noon.

MR U. ROLAND BURKE (President) IN THE CHAIR.

The PRESIDENT: My Lords, Ladies and Gentlemen, a year has passed since you did me the great honour of electing me as President of the Society. I had at that time considerable hesitation in undertaking the duties, combined with those of Honorary Director of the Show. I can only say that whatever qualms I had at that time in accepting the dual position were unnecessary, for the friendly help that I have received from members of the Council and indeed from everyone connected with the Society has made my duties light, and I am most grateful to all who have helped me, during a rather strenuous year, to carry out my duties in a manner which I hope has been acceptable to you. (Applause.)

The work of the Society during the year is very fully set out in the Report of the Council, which I trust you have all read, and I need not detain you by any lengthy reference to it; but there are a few matters to which I should like to refer without taking up too much of your time.

First of all, with regard to the Wolverhampton Show, which I am confident all who attended it will agree was a very great success, the attendance on the first three days was excellent and we had most beautiful weather, but unfortunately the weather broke down in the latter part of the week, which naturally affected the gate receipts. I am pleased, however, to be able to report to you to-day that, as you will see from the Show Accounts which have been placed in your hands, the Wolverhampton Show yielded a profit of nearly £700.

The Show was honoured by the presence of Their Royal Highnesses the Duke and Duchess of Gloucester, who wrote me a very kind letter saying how much they had enjoyed their visit.

We also had a very large number of visitors from overseas, and numerous letters have been received from them saying how very much they appreciated the arrangements which had been made for their comfort and welfare. Their visit naturally had a very favourable effect on the export trade, both in stock

and in machinery, and from enquiries I have made I think that the Wolverhampton Show was an excellent one for business generally.

I cannot close these remarks on the Wolverhampton Show without expressing my sincere thanks to Sir Charles Mander (the Mayor of Wolverhampton), the Town Council and all the officials of the town, to Lord Wrottesley, for lending us an extremely good site in his park, and to a great many others in a wide area in that part of England, who did everything possible to help to make the Show a success.

Since the Council have been good enough to elect me Honorary Director of the Show for the coming year, which I very much appreciate, I should like to say a word or two about our visit to Cardiff. All the preliminary arrangements are well in hand, and I think I can go so far as to say that success is assured. Lord Bute has once again come forward and offered us the same site adjoining the Castle, which has done duty for the Royal Show on two previous occasions. Further, you are shortly going to elect Lord Plymouth as President for the year 1938, and I cannot imagine, from my visits to Cardiff and the knowledge I have of the people there, that there is anything which will give greater satisfaction, both in Cardiff and in South Wales generally, than Lord Plymouth's election as President. I should like to take this opportunity of assuring him that he will receive from me and from everyone connected with the management of the affairs of the Society every possible help, in our endeavours to make his year of office a very pleasant one and the Cardiff Show an outstanding success. ("Hear, hear.")

In 1939 (to go a year further) we shall be celebrating, as you know, the Centenary of this Society, and it is my privilege to announce to you to-day that His Majesty the King has been graciously pleased to confer a great honour on the Society by signifying his intention to be our President during that year. (Applause.) Further, the Commissioners of Crown Lands, with the gracious approval of His Majesty, have given their consent to the Show being held in a portion of Windsor Great Park. The preliminary arrangements as to the methods of celebrating this event are under the consideration of the Council. I trust that the Windsor Show will be a landmark in the history of the Society and that we shall all join together in our efforts to make it worthy of the occasion. ("Hear, hear," and applause.)

I should like to say a word in regard to the paragraph of the Report dealing with the Membership of the Society. You will see from the Report that we have now only 8,800 members; there has been a steady decline in recent years, and I am sure you will agree that this is not what it should be. I want to appeal to all Governors and Members to assist the Council in every possible way in the efforts they are making to increase the membership and bring it up to a figure in keeping with the great traditions of the Society and in support of the invaluable work that it is doing year after year. It is only by personal effort that this can be achieved, by pointing out to non-members not only the privileges that they will gain by joining the Society but also that we want their help in carrying out our work.

With regard to the privileges, I have to announce to you that the Council decided at their meeting to-day that Members will not in future be asked to pay any fees at all for advice or assistance from the Royal Veterinary College, nor fees to the Society's Consulting Chemist or its other advisers. These services in future will be entirely free. ("Hear, hear.") I feel that that will be very greatly appreciated by the Members.

Further, arrangements are being made to add to the comfort of Members attending our Annual Show. It is proposed that improvements shall be carried out in the Members' Pavilion and that increased accommodation for Members on the Grand Stand shall be provided.

Is it too much to express the hope that by 1939, the Centenary of this

Society, under the Presidency of His Majesty the King, we may be able to announce a membership just double that of to-day? I appeal to our Governors and Members to use their personal efforts to try to bring that about.

I cannot close these remarks without saying how much I should like to thank the Council, the Governors and Members for the great kindness which they have shown me during my year of office, and Mr. Turner and our excellent staff for the valuable assistance they have given me throughout the year. It has not only rendered things easy for me, but made my year of office an extremely happy one. (Applause.)

Balance Sheet.

The PRESIDENT: My first duty is the presentation of the Balance Sheet for 1936 and the Accounts of the Wolverhampton Show, both of which are in your hands.

Report of the Council.

The PRESIDENT: The Report of the Council has been printed and circulated. May we take it as read? (Agreed.) I will ask Mr. R. S. Walters to move its adoption.

Mr. R. S. WALTERS: Mr. President, My Lords, Ladies and Gentlemen, as a Member of the Society living in the Midlands, I should like to congratulate the Council of the Royal Agricultural Society not only upon a most successful Show at Wolverhampton last summer, but also upon the increased Privileges which it is proposed to give to the Members. Whilst I have always felt that the pound or the guinea (I forget which it is) subscription which Members of the Society pay is one of the most profitable investments which a farmer can make in this country, I am quite sure that the concessions which have been suggested to-day should materially help to increase the membership of the Society.

The Wolverhampton Show, as you have said, Sir, was a great success. It is customary, I believe, for the mover of this resolution to be critical, but it is difficult for me to be critical, because the Wolverhampton Show was such a success; but I should just like to mention the motor facilities, or rather the lack of motor facilities, on the first evening of the Show, when I think it was suggested that we should visit or go in the direction of Bridgnorth, in the hope that we should find ourselves somewhere. I am rather inclined to think that several members of the Council took that route, and therefore the route was changed on the next day. Personally, I never follow the route laid down by the R.A.C. If I wish to go south-east, I invariably turn north-west. I take the second turn on the right, and I take the further second turn on the right, and I find myself in the correct direction, and I recommend the members of the Council to do likewise.

You have mentioned Windsor, Sir. May I make a suggestion, again not in the way of criticism? I remember that some seven or eight years ago, at the Agricultural Hall, I was bold enough to suggest that that long-suffering class of members, the exhibitors of live stock, should have a slight reduction in their entrance fees. As I see that the Society is bubbling over with funds —and it will bubble over to a still greater extent in the near future—I venture to suggest, for the consideration of the Council, that we should have, to celebrate the Centenary Show at Windsor, a further slight reduction in the entry fees.

With those few remarks and with every cordiality I congratulate the Council on the work they are doing, on the great success of the Wolverhampton Show, and on the great success of the work in general.

I have much pleasure in moving the adoption of the Report.

The Hon. ALEX. PARKER: Mr. President, My Lords, Ladies and Gentlemen, it gives me great pleasure to second the resolution which is before you. I think the Report is very full and very interesting.

There is just one point that I should like to mention, that is, that I entirely agree with the President when he says that the acquisition of members depends entirely on the personal element. I am quite sure that circulars, and propaganda of that sort, are of very little use, but that any number of members can be obtained if people will take the trouble to use their personal influence to secure them. For myself, I shall be very glad to do what I can in the matter.

The motion was put to the meeting by the President and was carried.

Election of President.

The PRESIDENT: The next item on the agenda is the election of the President, and I call upon Mr. Adeane to move the resolution.

Mr. ADEANE: Mr. President, My Lords, Ladies and Gentlemen, I have the pleasure and honour to move that the Earl of Plymouth be elected President of the Society to hold office until the next ensuing Annual General Meeting.

I move this resolution with very great confidence, because Lord Plymouth possesses all those qualifications which are desirable in the President of this Society. He joined the Society in 1928; he is a great landowner and therefore interested in agriculture; he breeds Guernsey cattle; he lives close to Cardiff, which we shall visit next year; and he is Lord Lieutenant of Glamorgan. I am quite sure that, as the President has said, the election of Lord Plymouth will be most popular in Wales. (Applause.)

When Lord Plymouth was asked to allow himself to be nominated as President for the coming year, he was somewhat diffident, because, being the Chairman of a very important Committee, he thought he might not be able to attend all the meetings of the Council. We were able to assure him that we were aware of the great work he was doing for the country and that we should welcome him here whenever he could attend. Our work here is non-contentious; we all speak one language (laughter); and it may be quite restful for Lord Plymouth to come here to the Chair of this Society after the stress and turmoil of international politics.

I am sure that Lord Plymouth's election to-day will ensure the success of the Society in the coming year, in so far as any human agency can ensure anything.

I beg to move. (Applause.)

The PRESIDENT: I will ask Mr. Hubert Alexander to second the resolution.

Mr. HUBERT ALEXANDER: Mr. President, My Lords, Ladies and Gentlemen, it is a very great privilege and a very great pleasure to me to second the motion proposed by Mr. Adeane.

Coming as I do from the county where his lordship lives and coming from the city of Cardiff, where the Show is to be held next year, I can say that it will give that district the greatest possible pleasure to hear that the Earl of Plymouth has been elected our President. It is a district where he holds an honoured name, where he is esteemed and, I think I may say without hesitation and without exaggeration, beloved by all members of the community. (Applause.) He is a generous patron, he is a considerate landlord and one who recognizes in the fullest sense of the word the obligations attached to the many high offices that he holds. (Applause.)

The motion was carried with acclamation.

Lord PLYMOUTH: Mr. President, My Lords, Ladies and Gentlemen, I am indeed very conscious of the honour that you have done me in electing me your President for the coming year. I should like to thank very warmly indeed both Mr. Adeane and Mr. Alexander for the very generous words which they used in recommending my election to you. It is a particular pleasure to me that Mr. Adeane should have consented to make this proposal, not only because of our close family connection and the memory of many happy days spent at Babraham whilst I was at Cambridge, but also because of the eminent part that Mr. Adeane has played for so many years in the activities of this great Society. ("Hear, hear.") It is an equal pleasure to me that Mr. Alexander should have consented to second this proposal, because, as he has said, we both come from South Wales, and I have had the opportunity and the privilege of working with him for many years in that part of the country.

Ladies and Gentlemen, I honestly feel that I am not as well qualified as many of my predecessors to hold the important office to which you have elected me. I am not and I have never professed to be a great authority on agriculture. As Mr. Adeane kindly pointed out, I have always taken the very deepest interest in the agricultural industry, but, when I look round this room and see the faces of so many acknowledged authorities on this subject, I cannot but approach my task with a good deal of diffidence. At the same time, I assure you that I am determined to do everything I possibly can to make my year of office as great a success as possible, and I feel certain that the people of Cardiff will come together to do what they can to further the interests of this Society at its Show there and will also do everything in their power to make the Cardiff Show of 1938 a really great success.

I only wish that I was rather more free than I am, to enable me to devote more time to the work of this Society whilst I am in office, because I do dislike treating any position I hold as a sinecure. I will attend all the meetings I possibly can, but you will appreciate, I am sure, the difficulty of the position in which I have been placed. I am very much encouraged by the fact that Mr. Burke has assured me not only that he will give me every possible assistance at any time, but that the whole Council will do the same. I can only hope that, as a result of that help, for which I am deeply grateful, my shortcomings will not be as apparent as they might otherwise be.

My Lords, Ladies and Gentlemen, I thank you again very much indeed for this great honour that you have done me, and I assure you that I will do the very best I can to further the interests of the Society during my year of office. (Applause.)

Election of Trustees.

The PRESIDENT: The next business on the agenda is the election of Trustees. It is customary for the Trustees to be elected by a show of hands. The names of the present Trustees who are, under Bye-law 141, recommended by the Council for re-election, are printed in List "A" on the agenda paper, and I will now ask you to signify in the usual manner whether it is your pleasure that these twelve noblemen and gentlemen should be elected Trustees of the Society to hold office until the next ensuing Annual General Meeting.

The names were as follows:—

H.R.H. The Duke of Gloucester, K.G., York House, St. James's Palace, S.W.1.
H.R.H. The Duke of Kent, K.G., 3, Belgrave Square, S.W.1.
Charles Adeane, C.B., Babraham Hall, Cambridge.
Duke of Bedford, K.G., Woburn Abbey, Bedfordshire.
Sir Merrik R. Burrell, Bt., C.B.E., Floodgates, West Grinstead.
Percy Crutchley, Sunninghill Lodge, Ascot, Berkshire.
Lord Daresbury, C.V.O., Walton Hall, Warrington.
Duke of Devonshire, K.G., Chatsworth, Bakewell, Derbyshire.
Lord Harlech, K.C.B., Brogyntyn, Oswestry, Shropshire.
Sir Arthur Hazlerigg, Bt., Noseley Hall, Leicestershire.
Lord Mildmay of Flete, Flete, Ivybridge, Devon.
Lt.-Col. E. W. Stanyforth, C.B., Kirk Hammerton Hall, York.

A show of hands was taken, and the Trustees were re-elected.

Election of Vice-Presidents.

The PRESIDENT : The next item on the agenda is the election of Vice-Presidents. I will ask you to signify by a show of hands whether it is your pleasure that the present Vice-Presidents, whose names are printed in list " B," should be re-elected to hold office until the next ensuing Annual General Meeting.

The names were as follows :—

U. Roland Burke, Edensor House, Bakewell, Derbyshire.
Col. The Right Hon. Sir G. L. Courthope, Bt., M.C., M.P., Whiligh, Sussex.
Earl of Derby, K.G., Knowsley, Prescot, Lancashire.
Lord Desborough, K.G., Taplow Court, Maidenhead.
John Evens, Burton, Lincoln.
R. M. Greaves, Wern, Portmadoc, North Wales.
Earl of Harewood, K.G., Harewood House, Leeds.
William Harrison, Albion Iron Works, Leigh, Lancashire.
Lord Hastings, Melton Constable Park, Norfolk.
Duke of Portland, K.G., Welbeck Abbey, Worksop, Notts.
Earl of Powis, Powis Castle, Welshpool, Mont.
Earl of Stradbroke, K.C.M.G., Henham Hall, Wangford, Beccles.

A show of hands was taken, and the Vice-Presidents were re-elected.

Election of Professional Accountants and Auditors.

Mr. R. CHAWNER : Mr. President, My Lords. Ladies and Gentlemen, I have the honour to move that Messrs. Price, Waterhouse & Co. be re-elected as Professional Accountants and Auditors for the ensuing year.

Mr. CLYDE HIGGS : I have pleasure in seconding that resolution.

The motion was carried.

Election of Ordinary Members of Council.

The PRESIDENT : Under the Bye-laws, the requisite measures have been taken to fill the vacancies on the Council in the representation of the Districts in Group " B." As Chairman, I have now formally to report to the Annual General Meeting the names and addresses of the Ordinary Members of the Council who have been elected by the several Divisions, in order that the meeting may, in the words of the Bye-law, " take cognisance of their election." This duty I formally fulfil by placing before you List " C," on pages 3 and 4 of the printed agenda paper, in which the names of the newly elected members are specially marked.

The names were as follows :—

Durham : Albert Weightman, Middle Herrington Farm, Sunderland.
Yorks. (West Riding) : C. W. H. Glossop, Bramwith Hall, near Doncaster.
Nottingham : Thomas Forshaw, The Stud, Carlton-on-Trent, Newark.
Leicester : W. Lindsay Everard, M.P., Ratcliffe Hall, Leicester.
Rutland : Capt. W. J. Baird, Deanscroft, Oakham.
Suffolk : Major Norman Everett, Rushmere, Ipswich, and Fred Smith, Deben Haugh, Woodbridge.
Buckingham : B. J. Gates, Pembury, Tring.
Essex : Sir Walter Gilbey, Bt., Elsenham Hall, Elsenham.
London : John Bell, The Hall, Thirsk, Yorks., and Lt.-Col. Sir Archibald G. Weigall, K.C.M.G., Englemere, Ascot, Berks.
Shropshire : William Everall, Berwick Mount, Shrewsbury, and J. Morris Belcher, Tibberton Manor, Wellington.
Hereford : William Smith, The Leen, Pembridge, Leominster.
South Wales : Capt. Hugh A. Christy, Llangoed, Llyswen, Breconshire.
Devon : Sir J. F. Shelley, Bt., Shobrooke Park, Crediton.
Wiltshire : The Earl of Radnor, Longford Castle, Salisbury.
Surrey : R. Borlase Matthews, Greater Felcourt, East Grinstead.

Resolution of Council on Foot and Mouth Disease.

The PRESIDENT : Before asking whether any Governor or Member has any remark to make or suggestion to offer, I should like to report to the

meeting that the Council this morning unanimously passed a resolution with regard to the slaughter policy in foot and mouth disease, arising out of the present outbreak of that disease. The wording of the resolution is as follows :—

"The Council of the Royal Agricultural Society of England desires to reiterate its unanimous opinion that in the present state of scientific knowledge of foot and mouth disease the only effective defence in this country against the spread of the disease is the prevailing policy of slaughter of all infected animals and all contacts. The Council desires therefore to assure His Majesty's Government of its full support in the policy now in operation."

It was resolved that that resolution should be forwarded to the Minister of Agriculture. ("Hear, hear.")

I thought the General Meeting might like to know of that resolution, and I feel sure that you will support it. We want to give a message to the Government that this Society fully supports them in the action which they are taking in their efforts to stamp out this disease, and we feel that this policy of slaughter is the only possible one to be pursued. I am sure that the Government will have the support of this meeting.

If any Governor or Member would like to speak on this matter we should be very glad to hear what he has to say.

I take it that that resolution has the approval of the meeting. (Agreed.)

Members' Suggestions.

I will now ask whether any Governor or Member has any remark to make or suggestion to offer that may be referred to the Council for their consideration.

Mr. George Wood : Mr. President, My Lords, Ladies and Gentlemen, I should like this Society to use its influence to have tractor lubricating oils brought within the ambit of the Fertilisers and Feeding Stuffs Act, so that in all transactions involving 5 gallons or more the flash point, cold set, and viscosities at certain temperatures must be stated on the invoice.

I should also like the Society to use its influence to see that the farmer's independence, as far as road haulage is concerned, be not curtailed, so that as horses are partly replaced by tractors the same freedom of the road should be extended to the tractor power that has always been the right of the horse power ; that is, freedom from tax and no restriction as to age of driver.

Captain Rolfe : The railway companies issue a useful time-table in connection with the Society's Show, but often the first time I see it is on the Showground. I have been in communication with the railway companies this year and asked them to let me have the time-table six weeks at least before the Show, and I would suggest that this Society, having more power than the people I represent, might ask the railway companies to bring out the time-table at least six weeks before the Show. I further suggest that a copy be sent to all the clubs in London ; it might bring to the notice of people that there is such a body as the Royal Agricultural Society and members of those clubs might attend the Show.

The President : I am sure the remarks and suggestions you have made, Mr. Wood and Captain Rolfe, will receive the careful consideration of the Council at their next meeting.

Mr. Crowley : I should like to make a suggestion about membership. I belong to the Highland and Agricultural Society as well as to this Society. In that Society a member may not retire or resign unless he compounds his

annual subscription for a life membership. (Laughter.) I think something of the sort should be done here.

The PRESIDENT: That sounds to me a most excellent idea.

Vote of Thanks to Retiring President.

Sir ARTHUR HAZLERIGG: My Lords, Ladies and Gentlemen, it is a very great pleasure to me, and I esteem it a great honour and privilege, to propose a very hearty vote of thanks to Mr. Roland Burke for his services as President during the past year. (Applause.)

When we elected Mr. Burke to this office at our last Annual Meeting I had only one doubt, and that was whether it was putting too much upon him to ask him to serve as both Honorary Director of the Show and President of the Society in one year. There are only two people whom I know who could possibly do it, namely, Lord Daresbury and Mr. Burke. They have both done it and they have done it as well as it could possibly be done. I now look at Mr. Burke to see if he has suffered anything from it, and I see that, in spite of all the hard work that he has done and the injury he sustained when he went into action with a motor bus, he looks better than ever. That shows that he is a very remarkable man. I am not surprised at that, because he was a very remarkable boy. When he first went to Eton he took Third Form, and he is the only person known who went from Third Form to Remove, missing out the whole of Fourth Form, in two halves. That reminds me of another old Etonian, who has just passed away, who must have been at Eton at much the same time as Mr. Burke—Major Sowler. He took Third Form, and, to the best of my recollection, he remained in it for two years. (Laughter.)

Mr. Burke's work for this Society is well known to you all. He became Assistant Steward first, incredible though it may appear, in the year 1893. Some of us think we have done a little work for this Society, but when we think of the years that Mr. Burke has served as Assistant Steward and Steward and all that he has done for the Society since he has been Honorary Director of the Show—a position which requires not only unremitting work and care but extraordinary tact—we are filled with gratitude for all he has done, especially for the way he has served us as President during the past year. It inspires us not only with respect for his abilities but also with great affection for him personally.

Sir MERRIK BURRELL: My Lords, Ladies and Gentlemen, I do not know whether Sir Arthur Hazlerigg had the same difficulty that I have in seeking how to express our thanks to Mr. Burke for all that he has done, but I can assure you of this, that I have never faced a task, however pleasurable, of greater difficulty than my present task of trying to put into words all that Mr. Burke has done for this Society during so many years.

Sir Arthur has dealt so well with Mr. Burke's work for the Society that I do not want to go over that ground again. I would rather look back to the days when I first knew Mr. Burke, when he was the Duke of Devonshire's agent at Eastbourne. The development of that charming town depended to a very great extent on Mr. Burke's early work there. For some years he kept the local Foxhounds going, when otherwise they would have become extinct. He gave the local Agricultural Society every possible help through many years, and the fact that the Sussex Agricultural Society is one of the best county societies in England to-day is due to a great extent to the assistance that Mr. Burke always gave us when he was agent at Eastbourne. He is not forgotten in Sussex, although his work, when he was moved to a position of greater responsibility, took him away from us to Derbyshire. After he had been in Derbyshire for some time, I had reason to be thankful to him for a great kindness that he did to me. I asked him whether he would start my eldest son on the way to acquiring the necessary knowledge to become one

day a landlord. Mr. Burke immediately took my son under his wing and was like a father to him, and I am very glad to have this opportunity of thanking him. Coming to the more immediate past, I shall never forget all the help he gave me last year, when I had the great honour to be your President. I think it is only when one has to work alongside Mr. Burke in that way that one can realize the full burden that he has borne for us in the last twelve months. I found it no light burden to be your President and it must be a tremendously heavy burden to be the Honorary Director of the Show. To combine those two offices in one year is almost an impossible task, but Mr. Burke seems to like impossible tasks, and to show people that they are not impossible he makes them possible. Few people would have thought that he could take over the work from Lord Daresbury and carry it on as he has. Nothing stands still; it either develops or decays. Nobody can say that the Royal Agricultural Society under Mr. Burke's management as President and Honorary Director has decayed. It has advanced. He has taken up a terrific body of work carried on by great men like Lord Daresbury, and the work has still gone ahead.

I would ask you, Ladies and Gentlemen, to realize how much we owe to Mr. Burke for all that he has done. He combines foresight, tact, kindliness and broadmindedness in a way vouchsafed to few people. His whole life, when it is not spent on the Duke of Devonshire's affairs, is spent in unceasing thought as to how he can serve the Royal Agricultural Society of England.

I have therefore great pleasure in seconding the vote of thanks to Mr. Burke.

The motion was put to the meeting by Sir Arthur Hazlerigg and was carried with acclamation.

The PRESIDENT: Sir Arthur Hazlerigg, Sir Merrik Burrell, My Lords, Ladies and Gentlemen, I thank you most sincerely for your very kind vote of thanks, and I do appreciate very deeply all that Sir Arthur and Sir Merrik, two very old and dear friends of mine, have said about my work.

If I have been at all successful in carrying out my duties during my year of office to your satisfaction, it is due to the great help and sympathy which have been given to me throughout the year by the Council and by everybody connected with the Society who has its welfare and the success of the Show at heart. I did feel rather conscious, during my week at Wolverhampton, of my many shortcomings, due, I suppose, to the necessity of the President being in one place and the Honorary Director in another; but I did try to do my best, and I think everyone sympathized with me in the difficulties in which I was placed.

I should like to say one other thing, and that is that I do owe a very great deal to the help which was given to me by my wife. (Applause.) She has helped me a very great deal during my year of office, especially with the social side of the Show, and I know all that it has meant to me during the year.

I do not think that any retiring President ever leaves the Chair here without feeling keen regret that his year of office is at an end. I do feel that to-day. I shall always remember the great honour that you bestowed on me in making me your President and I shall treasure nothing but the most happy memories of my year of office, with old friendships made closer and a great many new ones formed.

I thank you very much. (Applause.)

Royal Agricultural Society of England.

AWARDS OF PRIZES
AT
WOLVERHAMPTON, 1937.

ABBREVIATIONS.

R.N., Reserve Number. H.C., Highly Commended. C., Commended.

HORSES.

Shires.

No. 1.—Shire Horse Society's Champion Gold Medal for best Stallion to E. BOSTOCK'S Old House Conquering Mimic.
No. 18.—R.N. for Champion Gold Medal to J. MORRIS BELCHER'S Wootton Mimic.
No. 41.—Shire Horse Society's Champion Gold Medal for best Mare or Filly to SIR BERNARD GREENWELL'S Marden Daphne.
No. 33.—R.N. for Champion Gold Medal to JAMES GOULD'S Lymm Sunset.

Class 1.—*Shire Stallion, born in* **1934.**

1st, £20. No. 1.—E. BOSTOCK, Gibbet Hill, Coventry, Old House Conquering Mimic 42065.
2nd, £10. No. 6.—W. MILNER, Callaughton, Much Wenlock, Wenlock Avenger.
3rd, £5. No. 3.—WILLIAM J. CUMBER, Theale, Berks., Theale Rebel 42133.

R.N. No. 5.—JAMES GOULD, Crouchley Hall, Lymm, Cheshire, Lymm Lincoln 42032.
H.C. No. 2.

Class 2.—*Shire Stallion, born in* **1935.**

1st, £20. No. 11.—A. THOMAS LOYD, Lockinge House, Wantage, Tring Harvester.
2nd, £10. No. 8.—WILLIAM J. CUMBER, Theale, Berks., Theale Diplomat 42487.
3rd, £5. No. 9.—JAMES FORSHAW & SONS, Carlton-on-Trent, Newark, Carlton Winalot 42235.
4th, £4. No. 16.—SIR ERNEST S. WILLS, BT., Littlecote, Hungerford, Littlecote Royal 42365.

R.N. No. 13.—COL. A. F. NICHOLSON, C.B.E., Gunside, The Park, Leek, Batty Royal Ransom 42194.
H.C. No. 15. C. No. 14.

Class 3.—*Shire Stallion, born in* **1936.**

1st, £20. No. 18.—J. MORRIS BELCHER, Tibberton Manor, Wellington, Shropshire, Wootton Mimic.
2nd, £10. No. 20.—WILLIAM J. CUMBER, Theale, Berks., Bridge Hill What's Wanted.
3rd, £5. No. 21.—JAMES FORSHAW & SONS, Carlton-on-Trent, Newark, Carlton Prime Minister.

R.N. No. 19.—E. BOSTOCK, Gibbet Hill, Coventry, Culcliffe Stormer.
H.C. No. 22.

Class 4.—*Shire Mare, with her own foal at foot.*

1st, £20. No. 24.—JAMES GOULD, Crouchley Hall, Lymm, Cheshire, 126214 Lymm Lady Grey.

Class 5.—*Shire Colt or Filly Foal, the produce of a Mare entered in Class 4, or of a Filly in Class 7.**

1st, £10. No. 30.—JAMES GOULD, Crouchley Hall, Lymm, Cheshire, Lymm Stylish Boy

* Prizes offered by the Shire Horse Society.

Class 6.—*Shire Mare, born in or before* 1933, *not having a foal at foot. A Mare* 6 *years old or over must have produced a live foal in* 1936 *or* 1937.*

1st, £15. No. 33.—JAMES GOULD, Crouchley Hall, Lymm, Cheshire, 123153 **Lymm Sunset.**
2nd, £10. No. 32.—C. & M. BARKER, Stilton House, Helmsley, Yorks., 128077 **Ruth of Chippinghurst.**
3rd, £5. No. 35.—W. MILNER, Callaughton, Much Wenlock, 126522 **Wenlock Patience.**
R.N. No. 34.—NORMAN R. LLOYD, Walcot, Chirbury, Shropshire, 127160 **Severn Starlight.**

Class 7.—*Shire Filly, born in* 1934.

1st, £20. No. 41.—SIR BERNARD GREENWELL, BT., Marden Park, Woldingham, Surrey, 127872 **Marden Daphne.**
2nd, £10. No. 39.—R. J. CAMBIDGE, White Gate, Wheaton Aston, Stafford, 128210 **White Gate Marina.**
3rd, £5. No. 42.—SIR BERNARD GREENWELL, BT., Marden Park, 127877 **Marden Dora.**
R.N. No. 37.—C. & M. BARKER, Stilton House, Helmsley, Yorks., 127911 **Milady of Chippinghurst.**

Class 8.—*Shire Filly, born in* 1935.

1st, £20. No. 50.—SIR ERNEST S. WILLS, BT., Littlecote, Hungerford, 128833 **Littlecote Bluebell.**
2nd, £10. No. 44.—JAMES B. BROWN, Woodland House, Sturton-le-Steeple, Retford. 128927 **Mortaine Marina.**
3rd, £5. No. 49.—H. EADY ROBINSON, Higham Ferrers, Northants, 128830 **Lillingstone Lady Winagain.**
R.N. No. 45.—C. H. GOODWIN, Boro Fields, Walton-on-Trent, 128520 **Crossfields Marina.**
H.C. Nos. 46, 47. C. No. 48.

Class 9.—*Shire Filly, born in* 1936.

1st, £20. No. 55.—W. J. THOMPSON, Croyland, Woodham Road, Woking, **Chenies Mavis.**
2nd, £10. No. 52.—JAMES GOULD, Crouchley Hall, Lymm, Cheshire, **Lymm Peach.**
3rd, £5. No. 54.—NORMAN R. LLOYD, Walcot, Chirbury, Shropshire, **Severn Film Star.**

Class 10.—*Shire Gelding (by registered sire), born in or before* 1934.*

1st, £20. No. 58.—MANN, CROSSMAN & PAULIN, LTD., Albion Brewery, Whitechapel Road, London, E.1, **Albion Grey King.**
2nd, £15. No. 57.—W. R. FLEETWOOD, Roseville, Cotteridge, Birmingham, **Norton Statesman.**
3rd, £10. No. 60.—MANN, CROSSMAN & PAULIN, LTD., Whitechapel Road, **Hero.**
4th, £5. No. 62.—MANN, CROSSMAN & PAULIN, LTD., Whitechapel Road, **Newtown.**
5th, £5. No. 63.—MANN, CROSSMAN & PAULIN, LTD., Whitechapel Road, **Norman.**
R.N. No. 56.—A. FARQUHARSON, Greenhill Farm, Wombourne, Wolverhampton, **Prince.**

Class 11.—*Team of Three or Four Shire Horses (Mares, Geldings or Mixed), in Harness with Vehicle.*

1st, £10. No. 67.—MANN, CROSSMAN & PAULIN, LTD., **Team of Four Geldings.**

Clydesdales.

No. 72.—Clydesdale Horse Society's Champion Silver Medal for best Stallion to JAMES KILPATRICK'S **Craigie Topsman.**
No. 73.—R.N. for Champion Silver Medal to JAMES KILPATRICK'S **Hawkrigg Elect.**
No. 87.—Clydesdale Horse Society's Champion Silver Medal for best Mare or Filly to JAMES KILPATRICK'S **Craigie Moss Rose.**
No. 78.—R.N. for Champion Silver Medal to GEORGE MCDOWALL'S **Lucinda.**

Class 12.—*Clydesdale Stallion, born in* 1935.

1st, £20. No. 72.—JAMES KILPATRICK, Craigie Mains, Kilmarnock, **Craigie Topsman 22890**
2nd, £10. No. 70.—JAMES KILPATRICK, Craigie Mains, Kilmarnock, **Craigie Handsome Lad 22888.**

Class 13.—*Clydesdale Stallion, born in* 1936.

1st, £20. No. 73.—JAMES KILPATRICK, Hawkrigg House, Wigton, **Hawkrigg Elect.**
2nd, £10. No. 74.—JAMES KILPATRICK, Craigie Mains, Kilmarnock, **Craigie Malcolm.**

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* Prizes offered by the Shire Horse Society.

Class 14.—*Clydesdale Mare (not having a foal at foot), or Filly, born in or before* 1934. *A Mare 6 years old or over must have produced a live foal in* 1936 *or* 1937.

1st, £20. No. 78.—GEORGE MCDOWALL, Briarbrae, Stranraer. **Lucinda** (Vol. 55, p. 102).

Class 15.—*Clydesdale Filly, born in* 1935.

1st, £20. No. 83.—JAMES HAMILTON, Dunduff, Dunure, Ayrshire, **Dunduff Veronica.**
2nd, £10. No. 80.—ROBERT DALZIEL, Rue, Auldgirth, **Rue Ideal.**

Class 16.—*Clydesdale Filly, born in* 1936.*

1st, £15. No. 87.—JAMES KILPATRICK, Craigie Mains, Kilmarnock, **Craigie Moss Rose.**
2nd, £10. No. 88.—GEORGE MCDOWALL, Briarbrae, Stranraer, **Veronica.**

Class 17.—*Clydesdale Gelding (by registered sire), born in or before* 1934.*

1st, £20. No. 90.—A. FARQUHAR & SONS, Millersneuk, Lenzie, **Lenzie Jim.**
2nd, £10. No. 94.—JAMES MURDOCH, Netherton, Renfrew, **Renfrew.**
3rd, £5. No. 95.—WYNDHAM T. VINT, Thorn Cottage, Wroot, Doncaster, **Harry.**

Class 18.—*Clydesdale Gelding (by registered sire), shown in a single turn-out.*

1st, £20. No. 90.—A. FARQUHAR & SONS, Millersneuk, Lenzie, **Lenzie Jim.**

Class 19.—*Team of Three or Four Clydesdale Horses, mares, geldings or mixed, in harness with vehicle.*

[No Entry.]

Suffolks.

No. 105.—"Coronation" Perpetual Silver Challenge Cup for best Stallion to DENNIS WALKER'S **Holkham Pioneer.**
No. 129.—R.N. for "Coronation" Challenge Cup to F. NEWTON PRATT'S **Monarch of Morston.**
No. 147.—Suffolk Horse Society's Champion Prize of £10 for best Mare or Filly to FRANK SAINSBURY'S **Elmah of Wratting.**
No. 138.—R.N. for Champion Prize to P. ADAMS & SONS' **Laurel Golden Girl.**

Class 20.—*Suffolk Stallion, born in or before* 1933.†

1st, £20. No. 105.—DENNIS WALKER, Trowse, Norwich, **Holkham Pioneer 6120.**
2nd, £10. No. 102.—MARSH & BAXTER, LTD., Dunsley Hall Farms, Kinver, Staffs., **Laurel Sunshine 6351.**
3rd, £5. No. 104.—STUART PAUL, Kirton Lodge, Ipswich, **Woolverstone Eclipse 6207.**
R.N. No. 103.—R. H. & R. PAUL, Broxtead, Sutton, Woodbridge, **Broxtead Vanguard 6303.**
H.C. No. 99. C. Nos. 101, 106.

Class 21.—*Suffolk Stallion, born in* 1934.

1st, £20. No. 120.—DENNIS WALKER, Trowse, Norwich, **Wyverstone Monarch 6508.**
2nd, £10. No. 112.—FRANK SAINSBURY, Blunts Hall, Little Wratting, Haverhill, **Captain John 6625.**
3rd, £5. No. 110.—R. H. & R. PAUL, Broxtead, Sutton, Woodbridge, **Broxtead Jellicoe 6594.**
4th, £4. No. 113.—E. BRAITHWAITE SAVORY, Warren Farm, Streatley, Berks., **Laurel Goldfinder 6435.**
R.N. No. 118.—DENNIS WALKER, Trowse, Norwich, **Samford Questioner 6456.**
H.C. No. 116. C. Nos. 107, 115.

Class 22.—*Suffolk Stallion, born in* 1935.

1st, £20. No. 129.—F. NEWTON PRATT, Morston Hall, Trimley, Ipswich, **Monarch of Morston 6696.**
2nd, £10. No. 130.—SIR CUTHBERT QUILTER, BT., Bawdsey, Woodbridge, **Bawdsey Mandarin 6579.**
3rd, £5. No. 127.—J. A. MARSDEN POPPLE, Daneshill, Stevenage, Herts., **Daneshill Royal 6525.**
4th, £4. No. 126.—STUART PAUL, Kirton Lodge, Ipswich, **Samford Ruler 6561.**
R.N. No. 132.—SIR S. HANSON ROWBOTHAM, Dunsbury Farm, Brooke, Isle of Wight, **Mount Vigo 6572.**

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* Prizes offered by the Clydesdale Horse Society.
† Prizes offered by the Suffolk Horse Society.

Class 23.—*Suffolk Stallion, born in* 1936.

1st, £20. No. 136.—F. NEWTON PRATT, Morston Hall, Trimley, Ipswich, **Clansman of Morston 6747.**
2nd, £10. No. 137.—FRANK SAINSBURY, Blunts Hall, Little Wratting, Haverhill, **Wratting Sparkler 6693.**
3rd, £5. No. 135.—MARSH & BAXTER, LTD., Dunsley Hall Farms, Kinver, Staffs., **Dunsley Sir Roger 6626.**

Class 24.—*Suffolk Mare (with her own foal at foot).*

1st, £20. No. 147.—FRANK SAINSBURY, Blunts Hall, Little Wratting, Haverhill, **Elmah of Wratting 16863.**
2nd, £10. No. 138.—P. ADAMS & SONS, Laurel Farm, Felixstowe, **Laurel Golden Girl 17217.**
3rd, £5. No. 146.—SIR CUTHBERT QUILTER, BT., Bawdsey, Woodbridge, **Bawdsey Virginia 17339.**
4th, £4. No. 149.—FRANK SAINSBURY, Blunts Hall, Little Wratting, Haverhill, **Wratting Betty 16367.**

R.N. No. 142.—THE HON. L. W. JOYNSON-HICKS Newick Park, Sussex, **Newick Dawn 15694.**
H.C. No. 145. C. Nos. 139, 140.

Class 25.—*Suffolk Colt Foal, produce of Mare in Class* 24 *or of a Filly in Class* 28.*

1st, £10. No. 150.—P. ADAMS & SONS, Laurel Farm, Felixstowe, *d.* Laurel Golden Girl 17217.
2nd, £5. No. 154.—SIR CUTHBERT QUILTER, BT., Bawdsey, Woodbridge, *d.* Bawdsey Virginia 17339.
3rd, £3. No. 153.—THE HON. L. W. JOYNSON-HICKS, Newick, Park, Sussex, *d.* Newick Dawn 15694.

R.N. No. 151.—THE EARL OF BRADFORD, Weston Park, Shifnal, **Weston Monarch.**
H.C. No. 152.

Class 26.—*Suffolk Filly Foal, produce of Mare in Class* 24 *or of a Filly in Class* 28.*

1st, £10. No. 158.—FRANK SAINSBURY, Blunts Hall, Little Wratting, Haverhill, *d.* Elmah of Wratting 16863.
2nd, £5. No. 156.—EDWARD KAYLER, Shray Hill Farm, Wellington, Shropshire, **Shray Hill Countess of York 19433.**
3rd, £3. No. 159.—FRANK SAINSBURY, Blunts Hall, Little Wratting, Haverhill, *d.* Wratting Betty 16367.

R.N. No. 157.—MARSH & BAXTER, LTD., Dunsley Hall Farms, Kinver, Staffs., **Dunsley Rose.**
H.C. No. 155.

Class 27.—*Suffolk Mare, born in or before* 1933, *not having a foal at foot. A Mare* 6 *years old or over must have produced a live foal in* 1936 *or* 1937.*

1st, £15. No. 162.—R. H. & R. PAUL, Broxtead, Sutton, Woodbridge, **Broxtead Julia 16803.**
2nd, £10. No. 161.—THE EARL OF IVEAGH, C.B., C.M.G., Pyrford Court, Woking, **Pyrford Phantasy 17165.**
3rd, £5. No. 163.—FRED WALKER, Broadmead, Burstow, Horley, Surrey, **Sutton Star 16660.**

R.N. No. 160.—E. C. BACON, Raveningham Hall, Norwich, **Eastwell Careless 15827.**

Class 28.—*Suffolk Filly, born in* 1934.

1st, £20. No. 170.—FRANK SAINSBURY, Blunts Hall, Little Wratting, Haverhill, **Wratting Ursuline 17871.**
2nd, £10. No. 169.—F. NEWTON PRATT, Morston Hall, Trimley, Ipswich, **Ramsholt Liberty 17748.**
3rd, £5. No. 168.—THE EARL OF IVEAGH, C.B., C.M.G., Pyrford Court, Woking, **Pyrford Polly 17704.**
4th, £4. No. 164.—T. J. BAILEY, Hill Farm, Roxwell, Essex, **Roxwell Lady 17538.**

R.N. No. 171.—MISS EILEEN UNWIN, Palmers, Billingshurst, Sussex, **Raveningham Arabelle 17919.**
H.C. No. 167. C. Nos. 165, 173.

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* Prizes offered by the Suffolk Horse Society.

Class 29.—*Suffolk Filly, born in* 1935.

1st, £20. No. 178.—SIR CUTHBERT QUILTER, BT., Bawdsey, Woodbridge, **Bawdsey Shamrock 18517.**
2nd, £10. No. 179.—FRANK SAINSBURY, Blunts Hall, Little Wratting, Haverhill, **Wratting Sapphire 18457.**
3rd, £5. No. 180.—FRANK SAINSBURY, Blunts Hall, **Wratting Starlight 18458.**
4th, £4. No. 177.—J. A. MARSDEN POPPLE, Daneshill, Stevenage, Herts., **Beccles Doreen 18167.**

R.N. No. 181.—MISS EILEEN UNWIN, Palmers, Billingshurst, Sussex, **Godbolts Vanity 18300.**
H.C. No. 174. C. No. 175.

Class 30.—*Suffolk Filly, born in* 1936.

1st, £20. No. 187.—SIR CUTHBERT QUILTER, BT., Bawdsey, Woodbridge, **Bawdsey Charm 19168.**
2nd, £10. No. 183.—P. ADAMS & SONS, Laurel Farm, Felixstowe, **Laurel Model 18885.**
3rd, £5. No. 189.—FRED WALKER, Broadmead, Burstow, Horley, Surrey, **Trim Maid 18812.**

R.N. No. 186.—LADY LODER, Leonardslee, Horsham, **Leonardslee Caramel 18900.**
H.C. No. 188.

Class 31.—*Suffolk Gelding (by registered sire), born in or before* 1934.*

1st, £20. No. 196.—STUART PAUL, Kirton Lodge, Ipswich, **Captain.**
2nd, £10. No. 203.—FRANK WARREN, Godbolts, Marks Tey, Colchester, **Briton.**
3rd, £5. No. 200.—STUART PAUL, Kirton Lodge, Ipswich, **Stormer.**
4th, £4. No. 191.—LT.-COL. F. G. G. BAILEY, Lake House, Salisbury, **Major.**
5th, £3. No. 198.—STUART PAUL, Kirton Lodge, Ipswich, **Nelson.**

R.N. No. 199.—STUART PAUL, Kirton Lodge, Ipswich, **Short.**
H.C. Nos. 195, 202. C. Nos. 190, 192, 193.

Class 32.—*Team of Three or Four Suffolk Horses (Mares, Geldings or Mixed), in Harness, with Vehicle.*

1st, £10. No. 206.—STUART PAUL, Kirton Lodge, Ipswich.—Team of Four Geldings.
2nd, £5. No. 204.—LT.-COL. F. G. G. BAILEY, Lake House, Salisbury.—Team of Four Geldings.
3rd, £3. No. 205.—MITCHELLS & BUTLERS, Cape Hill Brewery, Birmingham.—Team of Four Geldings.

Percherons.

Winners of Challenge Cups offered by the British Percheron Horse Society:—
No. 215.—For the best Stallion born in Great Britain to CHIVERS & SONS' **Histon Bright Lad.**
No. 221.—R.N. to CHIVERS & SONS' **Histon Gay Traveller.**
No. 253.—For the best Filly born in Great Britain to CHIVERS & SONS' **Histon Bright Star 2nd.**
No. 241.—R.N. to CHIVERS & SONS' **Histon Lady Fair.**
No. 208.—For the best Stallion to CHIVERS & SONS' **Limon.**
No. 214.—R.N. to CANEWDON FARM'S **Napoleon.**
No. 228.—For the best Mare or Filly to CANEWDON FARM'S **Holme.**
No. 239.—R.N. to CANEWDON FARM'S **Norah.**

Class 33.—*Percheron Stallion, born in or before* 1934.

1st, £20. No. 208.—CHIVERS & SONS, LTD., Histon, Cambridge, **Limon B. 704.**
2nd, £10. No. 210.—CHIVERS & SONS, LTD., Histon, **Lieu B. 703.**
3rd, £5. No. 207.—LORD BROCKET, Brocket Hall, Welwyn, **Erpingham Thor B. 571.**

R.N. No. 211.—S. J. COLE, The Lodge, Winfarthing, Diss, **Stourhead Lagor 2nd B. 555.**

Class 34.—*Percheron Stallion, born in* 1935.

1st, £20. No. 214.—CANEWDON FARM, LTD., Scotts Hall, Canewdon, Essex, **Napoleon B. 734.**
2nd, £10. No. 215.—CHIVERS & SONS, LTD., Histon, Cambridge, **Histon Bright Lad B. 662.**
3rd, £5. No. 216.—S. J. COLE, The Lodge, Winfarthing, Diss, **Hobland Prince B. 711.**

R.N. No. 218.—ROBERT CHRYSTAL IRVING, Shenley Lodge, Ridge Hill, Barnet, **Aldenham Dick Turpin B. 669.**

Class 35.—*Percheron Stallion, born in* 1936.

1st, £20. No. 221.—CHIVERS & SONS, LTD., Histon, Cambridge, **Histon Gay TravellerB. 726.**
2nd, £10. No. 223.—CHIVERS & SONS, LTD., Histon, **Histon Plutocrat B. 727.**
3rd, £5. No. 222.—CHIVERS & SONS, LTD., Histon, **Histon Majestic B. 721.**

R.N. No. 227.—J. PIERPONT MORGAN, Wall Hall, Aldenham, Watford, **Aldenham Ulysses B. 709.**

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* Prizes offered by the Suffolk Horse Society.

Class 36.—*Percheron Mare (with her own foal at foot).*

1st, £20. No. 228.—CANEWDON FARM, LTD., Scotts Hall, Canewdon, Essex, **Holme B. 1477.**
2nd, £10. No. 230.—THOMAS COOK, Holland House, Bradwell, Gt. Yarmouth, **Louvette 1296.**
3rd, £5. No. 231.—J. PIERPONT MORGAN, Wall Hall, Aldenham, Watford, **Histon Lady 6th B. 835.**

Class 37.—*Percheron Colt or Filly Foal, produce of Mare in Class* 36.

1st, £10. No. 237.—J. PIERPONT MORGAN, Wall Hall, Aldenham, Watford, *d.* Histon Lady 6th B. 835.
2nd, £5. No. 234.—CANEWDON FARM, LTD., Scotts Hall, Canewdon, Essex, *d.* Holme B. 1477.
3rd, £3. No. 236.—THOMAS COOK, Hobland House, Bradwell, Gt. Yarmouth, *d.* Louvette B. 1296.

Class 38.—*Percheron Filly, born in* 1935.

1st, £20. No. 239.—CANEWDON FARM, LTD., Scotts Hall, Canewdon, Essex, **Norah B. 1401.**
2nd, £10. No. 240.—CANEWDON FARM, LTD., Canewdon, **Nina B. 1398.**
3rd, £5. No. 246.—THOMAS COOK, Hobland House, Bradwell, Gt. Yarmouth, **Noce B. 1474.**
4th, £4. No. 241.—CHIVERS & SONS, LTD., Histon, Cambridge, **Histon Lady Fair B. 1332.**
R.N. No. 244.—THOMAS COOK, Hobland House, Bradwell, Gt. Yarmouth, **Refaste B. 1466.**

Class 39.—*Percheron Filly, born in* 1936.*

1st, £20. No. 253.—CHIVERS & SONS, LTD., Histon Cambridge, **Histon Bright Star 2nd B. 1454.**
2nd, £10. No. 254.—S. J. COLE, The Lodge, Winfarthing, Diss, **Hobland Beauty B. 1421.**
3rd, £5. No. 255.—S. J. COLE, The Lodge, **Hobland Princess B. 1422.**
R.N. No. 252.—LORD BROCKET, Brocket Hall, Welwyn, Herts., **Brocket Ladybird B. 1483.**

Class 40.—*Percheron Gelding, by registered sire, born in or before* 1934.*

1st, £20. No. 257.—J. PIERPONT MORGAN, Wall Hall, Aldenham, Watford, **Aldenham Liberator B. 157.**

Class 41.—*Team of Three or Four Percheron Horses (Stallions, Mares, Geldings or Mixed), in harness with vehicle.*

[NO ENTRY.]

Hunters.

No. 319.—Hunters' Improvement and National Light Horse Breeding Society's Champion Gold Medal for best Mare to the HON. MRS. CLIVE BEHRENS' **Swinton Honora.**
No. 322.—R.N. for Champion Gold Medal to MRS. HARRY FRANK'S **Rosemary 3rd.**
No. 288.—Hunters' Improvement and National Light Horse Breeding Society's Champion Gold Medal for best Filly and R.N. for Challenge Cup for best young Hunter to MRS. HOWARD MANDER'S **Betty Jones.**
No. 295.—R.N. for Champion Gold Medal to LORD DIGBY'S **Orthia.**
No. 265.—Silver Challenge Cup for best young Hunter to MAJOR GORDON B. FOSTER'S **Firefly 2nd.**

Class 42.—*Hunter Gelding, born in* 1934.

1st, £20. No. 265.—MAJOR GORDON B. FOSTER, Leysthorpe, Oswaldkirk, York, **Firefly 2nd** (Supp. No. 2034).
2nd, £10. No. 260.—F. R. BENNION, Bellamys, Greenway, Ledbury, **Gay Lad** (Supp. No. 2125).
3rd, £5. No. 264.—MRS. PHILIP FLEMING, Barton Abbey, Steeple Aston, **Red Wine** (Supp. No. 1988).
4th, £4. No. 268.—C. W. F. PUDGE, Court-y-Park, Trumpet, Ledbury, **Bally Pixley.**
R.N. No. 259.—THE HON. MRS. CLIVE BEHRENS, Swinton Grange, Malton, **Swinton Honour Bright** (Supp. No. 1962).

Class 43.—*Hunter Gelding, born in* 1935.

1st, £20. No. 269.—SIR JOHN WM. BUCHANAN-JARDINE OF CASTLEMILK, BT., Norwood, Lockerbie, **Red Hot 2119.**
2nd, £10. No. 274.—MRS. HOWARD MANDER, Trysull Manor, Wolverhampton, **Paladin.**
3rd. £5. No. 270.—A. J. CREWDSON, Burdocks, Fairford, Glos., **Knockgorne** (Supp. No. 2140).
4th, £4. No. 277.—LT.-COL. BRIAN W. ROBINSON, M.C., Peewits Hill, Cirencester, **Steven.**
R.N. No. 273.—J. R. HINDLEY, Moorlands, Blacko, Nelson, **Watchman.**

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* **Prizes offered by the British Percheron Horse Society.**

Class 44.—*Hunter Colt or Gelding, born in* 1936.

1st, £20. No. 279.—MAJOR GORDON B. FOSTER, Leysthorpe, Oswaldkirk, York, **Flycatcher.**
2nd, £10. No. 280.—MRS. HARRY FRANK, Saddlewood Manor, Wotton-under-Edge, **Souvenir.**
3rd, £5. No. 284.—JOHN EDWARD JONES, Treworgan, Llangrove, Hereford, **Ballyliker.**
R.N. No. 286.—MRS. HOWARD MANDER, Trysull Manor, Wolverhampton, **Celebrity.**

Class 45.—*Hunter Filly, born in* 1934.

1st, £20. No. 288.—MRS. HOWARD MANDER, Trysull Manor, Wolverhampton, **8599 Betty Jones.**
2nd, £10. No. 289.—D. L. MILN, Abbots Bank, Westminster Avenue, Chester, **8296 Miss Grey 2nd.**
3rd, £5. No. 291.—LORD STAVORDALE, Evershot, Dorset, **8518 Bridget 15th.**

Class 46.—*Hunter Filly, born in* 1935.

1st, £20. No. 295.—LORD DIGBY, Minterne, Dorchester, **8303 Orthia.**
2nd, £10. No. 298.—MRS. HOWARD MANDER, Trysull Manor, Wolverhampton, **8600 Mary Ann 3rd.**
3rd, £5. No. 301.—CAPT. J. STEEL, Kirkwood, Lockerbie, **8488 Streamline.**
4th, £4. No. 303.—MRS. W. HARCOURT WEBB, Spring Grove, Bewdley, **May Day.**
R.N. No. 300.—LORD STAVORDALE, Evershot, Dorset, **8699 Orthodox.**

Class 47.—*Hunter Filly, born in* 1936.

1st, £20. No. 307.—LT.-COL. BRIAN W. ROBINSON, M.C., Peewits Hill, Cirencester, **8872 White Star.**
2nd, £10. No. 311.—MRS. E. M. VAUGHAN, Blackladies, Brewood, Stafford, **Roselet.**
3rd, £5. No. 309.—MRS. E. M. VAUGHAN, Blackladies, **Merry Maid.**
R.N. No. 312.—MISS G. M. YULE, Hanstead House, Bricket Wood, St. Albans, **Monclaire.**

Class 48.—*Hunter Mare (Novice) (with her own foal at foot).*

1st, £20. No. 317.—MISS JOAN LYSLEY, Pewsham House, Chippenham, **Booklet.**
2nd, £10. No. 316.—MORGAN T. JONES, Sugwas Farm, Hereford, **Sweetbriar.**
3rd, £5. No. 318.—WILLIAM YEO, Belladown, Newton Tracey, Barnstaple, **Marguerite.**
R.N. No. 314.—LORD DIGBY, Minterne, Dorchester, **8302 Austin Seven.**

Class 49.—*Hunter Mare (with her own foal at foot).*

1st, £20. No. 319.—THE HON. MRS. CLIVE BEHRENS, Swinton Grange, Malton, **6799 Swinton Honora.**
2nd, £10. No. 322.—MRS. HARRY FRANK, Saddlewood Manor, Wotton-under-Edge, **6505 Rosemary 3rd.**
3rd, £5. No. 321.—LORD DIGBY, Minterne, Dorchester, **7331 Kittywinks.**
4th, £4. No. 326.—MRS. HOWARD MANDER, Trysull Manor, Wolverhampton, **8383 Gaiety.**
5th, £3. No. 317.—MISS JOAN LYSLEY, Pewsham House, Chippenham, **Booklet.**
R.N. No. 316.—MORGAN T. JONES, Sugwas Farm, Hereford, **Sweetbriar.**

Class 50.—*Hunter Colt Foal, the produce of Mare in Classes* 48 *or* 49.

1st, £15. No. 327.—LORD DIGBY, Minterne, Dorchester, **Brisk.**
2nd, £10. No. 331.—MRS. HOWARD MANDER, Trysull Manor, Wolverhampton, **Gala.**
3rd, £5. No. 332.—WILLIAM YEO, Belladown, Newton Tracey, Barnstaple, *d.* **Marguerite.**
R.N. No. 330.—MISS R. M. HARRISON, O.B.E., Maer Hall, Newcastle, Staffs., *d.* **Lancia.**

Class 51.—*Hunter Filly Foal, produce of Mare in Classes* 48 *and* 49.

1st, £15. No. 337.—LORD DIGBY, Minterne, Dorchester, **Seta.**
2nd, £10. No. 336.—THE HON. MRS. CLIVE BEHRENS, Swinton Grange, Malton, **Swinton Helga.**
3rd, £5. No. 338.—MORGAN T. JONES, Sugwas Farm, Hereford, *d.* **Sweetbriar.**

Special Produce Prizes for best groups of young Hunters, by same sire, to :—

Sired by PAL-O'-MINE.

1st. Nos. 264, 274, 298.—MRS. PHILIP FLEMING'S **Red Wine**, and MRS. HOWARD MANDER'S **Paladin** and **Mary Ann 3rd.**

Sired by HOT HASTE.

2nd. Nos. 262, 269, 301.—SIR J. W. BUCHANAN-JARDINE'S **Gingerbread 2nd** and **Red Hot**, and CAPT. J. STEEL'S **Streamline.**

Sired by ORTHOS.

R.N. Nos. 294, 295, 300.—LORD DIGBY'S **Lady May 4th** and **Orthia**, and LORD STAVORDALE'S **Orthodox.**

Polo and Riding Ponies.

Winners of Medals offered by National Pony Society :—

No. 341.—Champion Gold Medal for the best Stallion or Colt to CAPT. W. H. FRANCE-HAYHURST'S Silverdale Loyalty.
No. 339.—R.N. for Champion Gold Medal to HERBERT BRIGHT'S Silverdale Tarragon.
No. 363.—Champion Gold Medal for the best Mare or Filly and Bronze Medal for the best Foal to HERBERT BRIGHT'S Silverdale Aquatint.
No. 351.—R.N. for Champion Gold Medal and Champion Silver Medal for the best Filly to HERBERT BRIGHT'S Silverdale Betonia.
No. 357.—R.N. for Champion Silver Medal for the best Filly to HERBERT BRIGHT'S Silverdale Felicity.
No. 365.—R.N. for Bronze Medal for the best Foal to MRS. W. LINDSAY EVERARD'S Audrey.

Class 52.—*Polo and Riding Pony Stallion, born in or before* 1934.

1st, £20. No. 341.—CAPT. W. H. FRANCE-HAYHURST, Bostock Hall, Middlewich, Silverdale Loyalty 1448.
2nd, £10. No. 339.—HERBERT BRIGHT, The Cove, Silverdale, Carnforth, Silverdale Tarragon 1918.
3rd, £5. No. 340.—MRS. CHAS. G. COE, Windlesham Hall, Windlesham, Surrey, Falconeri (Y.S.R., p. 156).

R.N. No. 342.—MRS. G. A. WRIGHT, Yelfords, Chagford, Devon, Hitler (Supp. 1933).

Class 53.—*Polo and Riding Pony Colt, Filly or Gelding, born in* 1936.

1st, £20. No. 344.—MRS. W. LINDSAY EVERARD, Ratcliffe Hall, Leicester, Kinloch (Supp. 1936).
2nd, £10. No. 346.—MRS. W. LINDSAY EVERARD, Ratcliffe Hall, Kittiwake (Supp. 1936).
3rd, £5. No. 348.—CAPT. W. H. FRANCE-HAYHURST, Bostock Hall, Middlewich, Silverine (Supp. 1936).

R.N. No. 347.—CAPT. W. H. FRANCE-HAYHURST, Bostock Hall, Coronation (Supp. 1936).
H.C. No. 350. C. No. 349.

Class 54.—*Polo and Riding Pony Colt, Filly or Gelding, born in* 1935.

1st, £20. No. 351.—HERBERT BRIGHT, The Cove, Silverdale, Carnforth, Silverdale Betonia (Supp. 1935).
2nd, £10. No. 352.—MISSES CALMADY-HAMLYN & DAWSON, Pearroc Vean, Buckfast, Devon, Jemima (Supp. 1935).
3rd, £5. No. 353.—CAPT. W. H. FRANCE-HAYHURST, Bostock Hall, Middlewich, Corona 3rd (Supp. 1935).

R.N. No. 355.—TRESHAM GILBEY, Whitehall, Bishops Stortford, Saucy Scottie (Y.S.R., p. 188).

Class 55.—*Polo and Riding Pony Filly or Gelding, born in* 1934.

1st, £20. No. 357.—HERBERT BRIGHT, The Cove, Silverdale, Carnforth, Silverdale Felicity (Supp. 1934).
2nd, £10. No. 359.—CAPT. W. H. FRANCE-HAYHURST, Bostock Hall, Middlewich, Silver Grit (Supp. 1934).
3rd, £5. No. 360.—TRESHAM GILBEY, Whitehall, Bishops Stortford, Amber (Supp. 1934).

R.N. No. 362.—MRS. G. A. WRIGHT, Yelfords, Chagford, Devon, Iona 3rd (Supp. 1934).

Class 56.—*Polo and Riding Pony Mare (with her own foal at foot).*

1st, £20. No. 363.—HERBERT BRIGHT, The Cove, Silverdale, Carnforth, 6680 Silverdale Aquatint.
2nd, £10. No. 366.—MRS. J. OSCAR MUNTZ, Foxhams, Horrabridge, S. Devon, 6063 Stolen Love.
3rd, £5. No. 365.—MRS. W. LINDSAY EVERARD, Ratcliffe Hall, Leicester, Audrey (A.M.R., p. 482).

R.N. No. 367.—A. SMITH-BINGHAM, Wykham Park, Banbury, Phillippa.

Arabs.

No. 368.—Arab Horse Society's Champion Silver Medal for best Arab Stallion or Colt to H. V. MUSGRAVE CLARK'S Saoud.
No. 380.—R.N. for Champion Silver Medal to LADY YULE'S Rakiba.
No. 384.—Arab Horse Society's Silver Medal for the best Filly to H. V. MUSGRAVE CLARK'S Belkis.
No. 388.—R.N. for Silver Medal to LADY YULE'S Ghezala.

Class 57.—*Arab Stallion, born in or before* 1933.*

1st, £15. No. 368.—H. V. Musgrave Clark, Courthouse, Offham, Lewes, **Saoud.**
2nd, £10. No. 372.—R. S. Summerhays, 19, Eastcheap, London, E.C.3, **Jaleel.**
3rd, £5. No. 369.—C. W. Hough, Hydes, Abridge, Essex, **Aluf.**

R.N. No. 371.—George Ruxton, Craven Lodge, Monk Sherborne, Basingstoke, **Algol.**

Class 58.—*Arab Stallion or Colt, born in* 1934, 1935 *or* 1936.

1st, £15. No. 380.—Lady Yule, Hanstead House, Bricket Wood, St. Albans, **Raktha.**
2nd, £10. No. 377.—R. E. L. Vaughan Williams, K.C., High Ashes Farm, Holmbury St. Mary, Dorking, **El Ghazi.**
3rd, £5. No. 381.—Lady Yule, Hanstead House, Bricket Wood, St. Albans, **Riffal.**

Class 59.—*Arab Filly, born in* 1934, 1935 *or* 1936.

1st, £15. No. 384.—H. V. Musgrave Clark, Courthouse, Offham, Lewes, **Belkis.**
2nd, £10. No. 383.—Lady Yule, Hanstead House, Bricket Wood, St. Albans, **Ghezala.**
3rd, £5. No. 382.—T. C. Armitage, Dene Court, Taunton, **Algola.**

R.N. No. 389.—Lady Yule, Hanstead House, Bricket Wood, St. Albans, **Sulka.**

Welsh Mountain Ponies.

Class 60.—*Welsh Mountain Pony Stallion, born in or before* 1934.

1st, £15. No. 392.—John Jones & Son, Dinarth Hall Pony Stud, Colwyn Bay, **Grove Will o' the Wisp 1260.**
2nd, £10. No. 391.—John Jones & Son, Dinarth Hall, **Bowdler Bright Light 1303.**
3rd, £5. No. 390.—Miss M. Brodrick, Coed Coch, Abergele, **Coed Coch Erlewyn 1590.**

Class 61.—*Welsh Mountain Pony Mare, born in or before* 1933, *not having a foal at foot. A Mare* 6 *years old or over must have produced a live foal in* 1936 *or* 1937.

1st, £15. No. 395.—John Jones & Son, Dinarth Hall Pony Stud, Colwyn Bay, **8703 Criban Socks.**
2nd, £10. No. 394.—Miss M. Brodrick, Coed Coch, Abergele, **7347 Grove Madcap.**
3rd, £5. No. 396.—Misses May & Summers, Manor House, Rodney Stoke, Cheddar, **5992 Clumber Miss Mary.**

R.N. No. 397.—Miss J. Pauling, The Lodge, Thame, Oxon., **8737 Criban Grey Swell.**

Shetland Ponies.

No. 402.—Shetland Pony Stud Book Society's Champion Silver Medal for best Pony to Mrs. Maurice Cox's **Rustic Sprite of Standen.**
No. 412.—R.N. for Champion Silver Medal to Mrs. E. M. Dick's **Helsa of Transy.**

Class 62.—*Shetland Pony Stallion, not exceeding* 10½ *hands, born in or before* 1934.

1st, £15. No. 402.—Mrs. Maurice Cox, Marshwood Manor, Bridport, Dorset, **Rustic Sprite of Standen 1343.**
2nd, £10. No. 403.—Mrs. E. M. Dick, Transy, Dunfermline, **Bergastor of Transy (Vol. 41, p. 55).**
3rd, £5. No. 405.—Mrs. E. M. Dick, Transy, Dunfermline, **Major of Earlshall 1316.**

R.N. No. 401.—Mrs. Maurice Cox, Marshwood Manor, Bridport, Dorset, **Alert of Maryfield (Vol. 39, p. 25).**
H.C. No. 400. C. No. 399.

Class 63.—*Shetland Pony Mare, not exceeding* 10½ *hands, born in or before* 1934, *with or without foal at foot. A Mare* 5 *years old or over must have produced a live foal.*

1st, £15. No. 412.—Mrs. E. M. Dick, Transy, Dunfermline, **4551 Helsa of Transy.**
2nd, £10. No. 408.—Mrs. G. E. Atkinson, Felbridge Park, East Grinstead, **4393 Peace of Coln.**
3rd, £5. No. 411.—Mrs. Maurice Cox, Marshwood Manor, Bridport, Dorset, **Rosa of Maryfield.**

R.N. No. 410.—Mrs. Maurice Cox, Marshwood Manor, **Barmaid of Marshwood.**
H.C. No. 409.

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* Prizes offered by the Arab Horse Society.

Riding Classes.

Hunters.

No. 473.—Perpetual Silver Gilt Challenge Cup for best Mare or Gelding to JOHN H. BETTS' **Danno.**

No. 461.—R.N. for Silver Gilt Challenge Cup to MRS. D. WILSON'S **Red Mike.**

Class 64.—*Hunter Mare or Gelding, born in* 1933.

1st, £15. No. 427.—JOHN EDWARD JONES, Treworgan, Llangrove, Hereford, **Royal Flush.**
2nd, £10. No. 445.—MISS G. M. YULE, Hanstead House, Bricket Wood, **Le Ra.**
3rd, £5. No. 442.—MAJOR W. HARCOURT WEBB, Spring Grove, Bewdley, **Pay Day** (Supp. No. 1839).
4th, £3. No. 431.—THOMAS L. PARKE, Withnall Fold Hall, Chorley, Lancs., **Adam.**
R.N. No. 438.—MAJOR W. H. TAYLOR, Burlingham, Pershore, **Cracksman.**

Class 65.—*Hunter Mare or Gelding (Novice), born in or before* 1933, *up to from* 12 *to* 14 *stones.*

1st, £15. No. 436.—W. J. SMITH, LTD., Holyport Hunting Stables, Maidenhead, **Holyport Prince.**
2nd, £10. No. 451.—MRS. MERVYN HILL, Knightshayes Home Farm, Tiverton, **Red Squirrel.**
3rd, £5. No. 457.—MRS. E. M. VAUGHAN, Blackladies, Brewood, Stafford, **Painter.**
4th, £3. No. 460.—MRS. D. WILSON, The Thatched House, Stratton Audley, Bicester, **Moorside.**
R.N. No. 428.—JOHN EDWARD JONES, Treworgan, Llangrove, Hereford, **Maid of the Mountains.**

Class 66.—*Hunter Mare or Gelding (Novice), born in or before* 1933, *up to more than* 14 *stones.*

1st, £15. No. 458.—MRS. E. M. VAUGHAN, Blackladies, Brewood, Stafford, **Winforton.**
2nd, £10. No. 437.—W. J. SMITH, LTD., Holyport Hunting Stables, Maidenhead, **Mandrake.**
3rd, £5. No. 463.—C. S. DRABBLE, Maynes Hill, Winslow, Bucks., **Fisherman.**
4th, £3. No. 464.—T. R. V. RENTON, Paddock House, Starbeck, Harrogate, **Loot.**
R.N. No. 438.—MAJOR W. H. TAYLOR, Burlingham, Pershore, **Cracksman.**

Class 67.—*Hunter Mare or Gelding, born in or before* 1932, *up to not more than* 14 *stones, suitable to carry a Lady, and to be ridden by a Lady (side-saddle).*

1st, £15. No. 473.—JOHN H. BETTS, Compton House, Kinver, Stourbridge, **Danno.**
2nd, £10. No. 477.—J. V. RANK, Ouborough, Godstone, Surrey, **Guilsborough.**
3rd, £5. No. 475.—CAPT. R. MACDONALD-BUCHANAN, Guilsborough Hall, Northampton, **Neptune.**
4th, £3. No. 433.—THOMAS L. PARKE, Withnall Fold Hall, Chorley, Lancs., **General Scamp.**
R.N. No. 466.—T. R. V. RENTON, Paddock House, Starbeck, Harrogate, **Holy Robin.**
H.C. No. 480.

Class 68.—*Hunter Mare or Gelding, born in or before* 1933, *up to from* 12 *to* 13·7 *stones.*

1st, £20. No. 477.—J. V. RANK, Ouborough, Godstone, Surrey, **Guilsborough.**
2nd, £15. No. 469.—BERNARD A. SELBY, The Garden Cottage, The Goffs, Eastbourne, **Ballymonis.**
3rd, £10. No. 433.—THOMAS L. PARKE, Withnall Fold Hall, Chorley, Lancs., **General Scamp.**
4th, £5. No. 436.—W. J. SMITH, LTD., Holyport Hunting Stables, Maidenhead, **Holyport Prince.**
5th, £3. No. 451.—MRS. MERVYN HILL, Knightshayes Home Farm, Tiverton, **Red Squirrel.**
R.N. No. 466.—T. R. V. RENTON, Paddock House, Starbeck, Harrogate, **Holy Robin.**
C. No. 480.

Class 69.—*Hunter Mare or Gelding, born in or before* 1933, *up to more than* 13·7 *stones, and not more than* 15 *stones.*

1st, £20. No. 473.—JOHN H. BETTS, Compton House, Kinver, Stourbridge, **Danno.**
2nd, £15. No. 470.—BERNARD A. SELBY, The Garden Cottage, The Goffs, Eastbourne, **Mortimer.**
3rd, £10. No. 429.—JOHN EDWARD JONES, Treworgan, Llangrove, Hereford, **China Cock.**
4th, £5. No. 437.—W. J. SMITH, LTD., Holyport Hunting Stables, Maidenhead, **Mandrake.**
5th, £3. No. 479.—MRS. H. SPALDING, Barrow-on-Soar, Leics., **B.P.**
R.N. No. 482.—W. C. DEVEREUX, Meads, Stoke Poges, Slough, **Gold Dust.**

Class 70.—*Hunter Mare or Gelding, born in or before* 1933, *up to more than* 15 *stones.*

1st, £20. No. 461.—MRS. D. WILSON, The Thatched House, Stratton Audley, Bicester, **Red Mike.**
2nd, £15. No. 424.—J. R. HINDLEY, Moorlands, Blacko, Nelson, **Golden Rain.**
3rd, £10. No. 472.—BERNARD A. SELBY, The Garden Cottage, The Goffs, Eastbourne, **Marlborough.**
4th, £5. No. 455.—HUGH SUMNER, Pashford Court, Droitwich, **Hunters Haven.**
5th, £3. No. 463.—C. S. DRABBLE, Maynes Hill, Winslow, Bucks., **Fisherman.**

R.N. No. 483.—LT.-COL. DONALD MACLEAY, Eastington House, Cirencester, **Flighty General.**

Weight-Carrying Cobs.

Class 71.—*Weight-carrying Cob, Mare or Gelding, not exceeding* 15 *hands.*

1st, £15. No. 484.—FREDERICK H. D. COURTNEY, Oxford Lodge, Bicester, **Clipston One.**
2nd, £10. No. 492.—LT.-COL. SIR ARCHIBALD WEIGALL, K.C.M.G., Englemere, Ascot, **Jorrocks.**
3rd, £5. No. 486.—MRS. INGE, Thorpe, Tamworth, **Marble.**
4th, £3. No. 489.—JOSEPH TAYLOR, Moss Hall, Stretton, Warrington, **Knut.**

R.N. No. 490.—BERNARD WARD, 14, Church Road, Edgbaston, Birmingham, **Marquessa.**

Hacks.

No. 485.—Silver Challenge Cup, for the best Animal in Classes 71 to 73, to FREDERICK H. D. COURTNEY'S **Dancing Comet.**
No. 484.—R.N. for Challenge Cup to FREDERICK H. D. COURTNEY'S **Clipston One.**

Class 72.—*Hack Mare or Gelding, not exceeding* 15·1 *hands.*

1st, £10. No. 485.—FREDERICK H. D. COURTNEY, Oxford Lodge, Bicester, **Dancing Comet.**
2nd, £5. No. 503.—MRS. WALTER E. LLOYD. The Cottage, Ditton Hill, Surrey, **Matze.**
3rd, £3. No. 508.—LADY HUNLOKE, 19a, Kinnerton Street, London, S.W.1, **Forecast.**

R.N. No. 509.—E. & T. HOLLAND-MARTIN, Overbury, Tewkesbury, **Leerie.**

Class 73.—*Hack Mare or Gelding, not exceeding* 15·1 *hands, suitable to carry a Lady and to be ridden by a Lady (Side-Saddle).**

1st, £10. No. 485.—FREDERICK H. D. COURTNEY, Oxford Lodge, Bicester, **Dancing Comet.**
2nd, £5. No. 509.—E. & T. HOLLAND-MARTIN, Overbury, Tewkesbury, **Leerie.**
3rd, £3. No. 508.—LADY HUNLOKE, 19a, Kinnerton Street, London, S.W.1, **Forecast.**

R.N. No. 511.—MRS. M. V. HUGHES, Dingley Lodge, Market Harborough, **Forty Winks.**

Children's Ponies.

No. 528.—Champion Silver Cup, offered by Lady Daresbury, for the best Pony to WILLIAM BENSON'S **Flash.**
No. 516.—R.N. for Champion Silver Cup to S. H. BROOKSHAW'S **Sandy.**

Class 74.—*Pony Mare or Gelding, not exceeding* 12·2 *hands. To be ridden by a child who has not attained his or her* 11*th birthday on the* 9*th July,* 1937.

1st, £10. No. 516.—S. H. BROOKSHAW, Aychley, Market Drayton, **Sandy.**
2nd, £5. No. 519.—MRS. M. V. HUGHES, Dingley Lodge, Market Harborough, **Gwynno.**
3rd, £3. No. 520.—T. L. PARKE, Withnall Fold, Chorley, Lancs., **Silver Mist.**
4th, £1. No. 518.—MRS. A. R. HEPBURN, Orchard Road, Erdington, Birmingham, **Rhos.**

R.N. No. 514.—J. A. BELLAMY, Maisemore, Gloucester, **Dolly.**
H.C. No. 522.

Class 75.—*Pony Mare or Gelding, over* 12·2 *and not exceeding* 13·2 *hands. To be ridden by a child who has not attained his or her* 14*th birthday on the* 9*th July,* 1937.

1st, £10. No. 528.—WILLIAM BENSON, Harrowby Fields, Grantham, **Flash.**
2nd, £5. No. 530.—R. H. EVANS, 6, Park Street, Wellington, Shropshire, **Fairy.**
3rd, £3. No. 501.—BARBARA T. CLIFF, The Grove, Scawby, Brigg, **Gold Dust.**
4th, £1. No. 524.—S. H. BROOKSHAW, Aychley, Market Drayton, **Sweet Surprise.**

R.N. No. 527.—FRANK ASTON, Condover Grange, Condover, Shrewsbury, **Delight.**
H.C. No. 531.

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*Prizes offered by Associations interested in Hacks.

Class 76.—*Pony Mare or Gelding, over* 13·2 *and not exceeding* 14·2 *hands. To be ridden by a child who has not attained his or her* 16*th birthday on the* 9*th July,* 1937.

1st, £10. No. 540.—WILLIAM BENSON, Harrowby Fields, Grantham, **Tabarina.**
2nd, £5. No. 502.—BARBARA T. CLIFF, The Grove, Scawby, Brigg, **Bramble.**
3rd, £3. No. 535.—MRS. M. V. HUGHES, Dingley Lodge, Market Harborough, **Deliah.**
4th, £1. No. 536.—B. SPOONER, Streetly Riding School, Manor Road, Streetly, **Valencia.**

R.N. No. 537.—KENNETH ASTON, Condover Grange, Condover, Shrewsbury, **Condover Mignonette.**

Driving Classes.

SINGLE HARNESS.

No. 565.—Champion Prize of £20 for the best Animal not exceeding 14 hands to MRS. EDGAR HENRIQUE'S **Fleetwood Creation.**
No. 589.—R.N. £10 for Champion Prize to J. E. RUSHWORTH'S **Stonehedge Brigadier.**
No. 567.—The President's Challenge Cup for the best Animal and Champion Prize of £20 for the best Animal over 14 hands to MRS. EDGAR HENRIQUE'S **Fleetwood Viking.**
No. 554.—R.N. for the President's Challenge Cup and R.N. £10 for Champion Prize to NIGEL C. COLMAN'S **Nork Spotlight.**

Class 77.—*Harness Stallion, Mare or Gelding (Novice), not exceeding* 14 *hands.*

1st, £15. No. 587.—J. E. RUSHWORTH, 98, Bathgate, Grimsby, **Habrough Autocrat,** G. 918.
2nd, £10. No. 589.—J. E. RUSHWORTH, 98, Bathgate, Grimsby, **Stonehedge Brigadier.**
3rd, £5. No. 601.—BERTRAM W. MILLS, Pollards Wood, Chalfont St. Giles, Bucks.

R.N. No. 561.—MRS. EDGAR HENRIQUES, Fernholm, Hesketh Park, Southport, **Fleetwood Oliver.**
H.C. No. 557.

Class 78.—*Harness Stallion, Mare or Gelding (Novice), over* 14 *hands.*

1st, £15. No. 562.—MRS. EDGAR HENRIQUES, Fernholm, Hesketh Park, Southport, **Fleetwood Valour.**
2nd, £10. No. 590.—JOSEPH MORTON, Dial House, Downham Market, **Vertu.**
3rd, £5. No. 551.—NIGEL C. COLMAN, M.P., 49, Grosvenor Square, London, W.1, 27269 **Nork Sapphire.**

R.N. No. 581.—FRANK C. MINOPRIO, Broadlands, Ascot, 27144 **Mersey Princess.**

Class 79.—*Harness Stallion, Mare or Gelding, not exceeding* 13·2 *hands.*

1st, £15. No. 594.—MR. AND MRS. WALTER BRIGGS, Linden Hall, Borwick, Carnforth, 26769 **Barcroft Belle.**
2nd, £10. No. 553.—NIGEL C. COLMAN, M.P., 49, Grosvenor Square, London, W., 26923 **Cassilis High and Mighty.**
3rd, £5. No. 563.—MRS. EDGAR HENRIQUES, Fernholm, Hesketh Park, Southport, **Fleetwood Petal.**

R.N. No. 587.—J. E. RUSHWORTH, 98, Bathgate, Grimsby, **Habrough Autocrat** G. 918.

Class 80.—*Harness Stallion, Mare or Gelding, over* 13·2 *and not exceeding* 14 *hands.*

1st, £15. No. 565.—MRS. EDGAR HENRIQUES, Fernholm, Hesketh Park, Southport, **Fleetwood Creation.**
2nd, £10. No. 595.—PAUL HOFFMANN, 4, Cardigan Mansions, Richmond Hill, Surrey, 26895 **Oxford Caprice.**
3rd, £5. No. 582.—FRANK C. MINOPRIO, Broadlands, Ascot, **Mickey Mouse** G. 787.

R.N. No. 603.—BERTRAM W. MILLS, Pollards Wood, Chalfont St. Giles, Bucks.

Class 81.—*Harness Stallion, Mare or Gelding, over* 14 *and not exceeding* 15 *hands.*

1st, £15. No. 554.—NIGEL C. COLMAN, M.P., 49, Grosvenor Square, London, W.1, **Nork Spotlight** 14747.
2nd, £10. No. 566.—MRS. EDGAR HENRIQUES, Fernholm, Hesketh Park, Southport, **Fleetwood Nanette.**
3rd, £5. No. 558.—JAMES AGATE, 22, Antrim Mansions, Antrim Road, London, N.W.3, **Ego.**

R.N. No. 597.—PAUL HOFFMANN, 4, Cardigan Mansions, Richmond Hill, Surrey, 26692 **Modern Miss.**

Class 82.—*Harness Stallion, Mare or Gelding, over* 15 *hands.*

1st, £15. No. 567.—Mrs. Edgar Henriques, Fernholm, Hesketh Park, Southport, **Fleetwood Viking.**
2nd, £10. No. 583.—Frank C. Minoprio, Broadlands, Ascot, Pollux G. 775.
3rd, £5. No. 604.—Bertram W. Mills, Pollards Wood, Chalfont St. Giles, Bucks.

R.N. No. 598.—Paul Hoffmann, 4, Cardigan Mansions, Richmond Hill, Surrey, **Orford Victor 14370.**

Double Harness.

Class 83.—*Pair of Stallions, Mares or Geldings, not exceeding* 14 *hands.*

1st, £15. Nos. 582, 584.—Frank C. Minoprio, Broadlands, Ascot, **Mickey Mouse** G. 737. **and King of the Lawn** G. 893.
2nd, £10. Nos. 563, 565.—Mrs. Edgar Henriques, Fernholm, Hesketh Park, Southport, **Fleetwood Petal and Fleetwood Creation.**
3rd, £5. Nos. 550, 552.—Nigel C. Colman, M.P., 49, Grosvenor Square, London, W., **27193 Nork Firefly and Nork Magnet** G. 579.

R.N. No. 603.—Bertram W. Mills, Pollards Wood, Chalfont St. Giles, Bucks., Pair of Bays.

Class 84.—*Pair of Stallions, Mares of Geldings, over* 14 *hands.*

1st, £15. Nos. 562, 566.—Mrs. Edgar Henriques, Fernholm, Hesketh Park, Southport, **Fleetwood Valour and Fleetwood Nanette.**
2nd, £10. Nos. 585, 586.—Frank C. Minoprio, Broadlands, Ascot, **Gay Boy and Merry Girl.**
3rd, £5. Nos. 602, 604.—Bertram W. Mills, Pollards Wood, Chalfont St. Giles, Bucks., Pair of Blacks.

R.N. Nos. 598, 599.—Paul Hoffmann, 4, Cardigan Mansions, Richmond Hill, Surrey, **Orford Victor 14370 and 26550 Orford Gavotte.**

Tandems.

Class 85.—*Tandem, Stallions, Mares or Geldings, not exceeding* 14 *hands.*

1st, £15. Nos. 582, 584.—Frank C. Minoprio, Broadlands, Ascot, **Mickey Mouse** G. 918 **and King of the Lawn** G. 893.
2nd, £10. No. 603.—Bertram W. Mills, Pollards Wood, Chalfont St. Giles, Bucks., Pair of Bays.
3rd, £5. Nos. 563, 565.—Mrs. Edgar Henriques, Fernholm, Hesketh Park, Southport, **Fleetwood Petal and Fleetwood Creation.**

Class 86.—*Tandem, Stallions, Mares or Geldings, over* 14 *hands.*

1st, £15. Nos. 598, 599.—Paul Hoffmann, 4, Cardigan Mansions, Richmond Hill, Surrey, **Orford Victor 14370 and 26550 Orford Gavotte.**
2nd, £10. Nos. 602, 604.—Bertram W. Mills, Pollards Wood, Chalfont St. Giles, Bucks., Pair of Blacks.
3rd, £5. Nos. 585, 586.—Frank C. Minoprio, Broadlands, Ascot, **Gay Boy and Merry Girl.**

Mounted Police.

Class 1.—*Single Horse, Mare or Gelding.*

1st, £10. No. 634.—Salford City Police, Town Hall, Salford, **Stretton**
2nd, £5. No. 624.—Bristol Watch Committee, Bridewell Street, Bristol, **Gold Flake.**
3rd, £3. No. 611.—Birmingham City Police, Corporation Street, Birmingham, **Captain.**
4th, £2. No. 637.—City of Sheffield Police, Castle Green, Sheffield, **Duchess.**
5th, £1 No. 623.—Bristol Watch Committee, Bridewell Street, Bristol, **Clifton.**
H.C. Nos. 615, 618, 626, 631, 633. **C.** Nos. 616, 625, 628, 629, 635.

Class 2.—*Two Horses, Mares or Geldings.*

1st, £10. Nos. 629, 630.—Manchester City Police, Town Hall, Manchester, **Billy and General.**
2nd, £5. Nos. 625, 626.—Lancashire Constabulary, Preston, **Lonsdale and Duke.**
3rd, £3. Nos. 631, 632.—Newcastle-upon-Tyne Police, Pilgrim Street, Newcastle-upon-Tyne, **Prince and Peter.**
4th, £2. Nos. 637, 638.—City of Sheffield Police, Castle Green, Sheffield, **Duchess and Robin.**
5th, £1. Nos. 633, 635.—Salford City Police, Town Hall, Salford, **Cherry Grove and Crescent.**

R.N. Nos, 618, 619.—Birmingham City Police, Corporation Street, Birmingham, **Prince and Susan.**
H.C. Nos. 610, 611.

Horse Jumping Competitions.

Class A.—*Mare or Gelding.*

1st, £20. No. 16.—GRANGE BROS., Alvaston, Nantwich, **Desire.**
2nd, £15; 3rd, £10; 4th, £5 (divide). No. 14—S. W. WOODHALL, Mount Pleasant, Wellington, Shropshire, **Marina**; No. 19—F. W. FOSTER, Friary Farm, Etwall, Derby, **Swank**; and No. 43—A. MASSARELLA & SONS, Belmont, Bentley, Doncaster, **Silver Mint.**
5th, £3. No. 44.—THOMAS MAKIN, Newton Farm, Newton, Castleford, **Tony.**
6th, £3 (divide). No. 9—S. W. WOODHALL, Mount Pleasant, Wellington, Shropshire, **Red Rufus**; No. 24—MISS IRENE CHAMBERS, The Hollies, Langside Drive, Glasgow, **Ann Tucker**; and No. 41—LADY WRIGHT, Durley Riding School, Burbage, Wilts., **Toby.**

Class B.—*Mare or Gelding.*

1st, £20; 2nd, £15; 3rd, £10; 4th, £5 (divide). No. 7—A. MASSARELLA & SONS, Belmont, Bentley, Doncaster, **Silver Mint**; No. 14—THOMAS MAKIN, Newton Farm, Newton, Castleford, **Crackle**; No. 18—GRANGE BROS., Alvaston, Nantwich, **Desire**; and No. 39—F. W. FOSTER, Friary Farm, Etwall, Derby, **Swank.**
5th, £3. No. 6.—JOSEPH TAYLOR, Moss Hall, Stretton, Warrington, **Exchange.**
6th, £3. No. 4.—JOSEPH TAYLOR, Moss Hall, Stretton, Warrington, **Praters.**

Class C.—*Mare or Gelding.*

1st, £20; 2nd, £15; 3rd, £10; 4th, £5; 5th, £3 (divide). No. 7—LADY WRIGHT, Durley Riding School, Burbage, Wilts., **Toby**; No. 19—S. W. WOODHALL, Mount Pleasant, Wellington, Shropshire, **Red Rufus**; No. 20—JOSEPH TAYLOR, Moss Hall, Stretton, Warrington, **Bon Bon**; No. 22—A. MASSARELLA & SONS, Belmont, Bentley, Doncaster, **Silver Mint**; and No. 39—THOMAS MAKIN, Newton Farm, Newton, Castleford, **Tony.**
6th, £3 (divide). No. 1—THOMAS GLENCROSS, The Chestnuts, Seagry, Chippenham, **Blue Sky**; No. 2—S. W. WOODHALL, Mount Pleasant, Wellington, Shropshire, **Marina**; No. 13—F. W. FOSTER, Friary Farm, Etwall, Derby, **Huntsman** and No. 15—**Swank**; No.21—E. ADCOCK, The Grange, Thurmaston, Leicester, **Sandy**; No. 31—GRANGE BROS. Alvaston, Nantwich, **Desire**; and No. 40—MRS. R. WHITEHEAD, Bryn Rhydderch, Abergavenny, **Walton.**

Class D.—*Mare or Gelding.*

1st, £20; 2nd, £15 (divide). No. 7—F. W. FOSTER, Friary Farm, Etwall, Derby, **Huntsman**; and No. 8, MRS. R. WHITEHEAD, Bryn Rhydderch, Abergavenny, **Walton.**
3rd, £10; 4th, £5; 5th, £3 (divide). No. 26—GRANGE BROS., Alvaston, Nantwich, **Desire**; No. 36—MISS IRENE CHAMBERS, The Hollies, Langside Drive, Glasgow, **Ann Tucker**; and No. 40—E. ADCOCK, The Grange, Thurmaston, Leicester, **Sandy.**
6th, £3 (divide). No. 16—F. W. FOSTER, Friary Farm, Etwall, Derby, **Snowflake**; No. 25—JOSEPH TAYLOR, Moss Hall, Stretton, Warrington, **Bon Bon**; No. 30—THOMAS GLENCROSS, The Chestnuts, Seagry, Chippenham, **Peter Pan**; and No. 38—LADY WRIGHT, Durley Riding School, Burbage, Wilts., **Toby.**

Class E.—*Consolation Class for animals which have not won a prize or prizes amounting in the aggregate to £5.*

1st, £15. No. 71.—E. ADCOCK, The Grange, Thurmaston, Leicester, **Pola.**
2nd, £10; 3rd, £5; 4th, £5; 5th, £3; 6th, £3 (divide). No. 46—A. J. SKIDMORE, Forge Mill Farm, West Bromwich, **Aircraft**; No. 54—THOMAS GLENCROSS, The Chestnuts, Seagry, Chippenham, **Peter Pan**; No. 55—GRANGE BROS., Alvaston, Nantwich, **Never Mind** and No. 65—**Found**; No. 66—D. W. DOBSON, High Ash, Nantwich, **Sparkel.**

Children's Jumping Competitions.

Open to Members and Associates of the following Branches of the Pony Club :—Albrighton, Albrighton Woodland, Worcestershire, North Shropshire, South Shropshire, North Staffordshire, South Staffordshire.

Class 1.—*Inter-Branch Competition; Teams of Three Riders.*

1st, **Hunting Crops.** PAULA GLAZE, Pelham Lodge, Kidderminster; SHEILA FITTER, 17, Westfield Road, Edgbaston; and DAWN MACKEY, Highfield Road, Edgbaston (Albrighton Woodland Pony Club).
2nd, **Silver Cups.** DENNIS HAYNES, Woodlands, Tittensor, Stoke-on-Trent; JOAN TURNER-Walton Hurst, Eccleshall; and ELEANOR MORRIS, Handsford Farm, Eccleshall (North Staffordshire Pony Club).
3rd, **Silver Cups.** PATRICK HICKMAN, Trysull Manor, Wolverhampton; MARGERY GOLCHER, Ridgemead, Penn, Wolverhampton; and MOLLY CAMBIDGE, White Pump Farm, Wheaton Aston, Stafford (Albrighton Pony Club).

Class 2.—*Individual Jumping.*

1st, Silver Cup. SHEILA SPOONER, Hill Crest, Foley Road, Streetly, Staffs. (South Stafford, shire Pony Club).
2nd, Silver Cup. PAUL WOODHALL, Mount Pleasant, Wellington, Shropshire (North Shropshire Pony Club).
3rd, Silver Cup. KATHLEEN TERRY, Newshipton Farm, Walmley, Birmingham (South Staffordshire Pony Club).

CATTLE.

Unless otherwise stated the Prizes for Cattle are as follows: First Prize, £15; Second Prize, £10; Third Prize, £5; Fourth Prize, £4; Fifth Prize £3.

Shorthorns.

No. 701.—Argentine Silver Challenge Cup for the best Bull bred by Exhibitor; Shorthorn Society's Champion Prize of £20 for the best Bull; and Brothers Colling Memorial Challenge Cup for the best Shorthorn to CAPT. J. MACGILLIVRAY'S **Calrossie Control.**
No. 718.—R.N. for Argentine Silver Challenge Cup to J. V. RANK'S **Bapton Leader Royal.**
No. 710.—R.N. for Shorthorn Society's Champion Prize to R. WEMYSS HONEYMAN'S **Calrossie Silver Wedding.**
No. 753.—R.N. for Brothers Colling Memorial Challenge Cup and Shorthorn Society's Champion Prize of £20 for the best Cow or Heifer to J. V. RANK'S **Bapton Crocus 24th.**
No. 757.—R.N. for Shorthorn Society's Championship Prize to J. V. RANK'S **Bapton Augusta 11th.**
Shorthorn Society's Special Prizes for the best groups of three Shorthorns bred by Exhibitor:—
1st, £15, Nos. 718, 740, 764.—J. V. RANK'S **Bapton Leader Royal, Bapton Aerial and Bapton Eliza 7th.**
2nd, £10, Nos. 741, 765, 783.—W. MCNAIR SNADDEN'S **Coldoch Silver Crest, Coldoch Beauty 2nd and Lavender Lady.**
R.N. Nos. 749, 766, 784.—DUNCAN M. STEWART'S **Millhills Solomon, Cherrywood 9th and Millhills Royal Princess 4th.**

Class 87.—*Shorthorn Bull, born in or before* 1934.

1st, No. 701.—CAPT. J. MACGILLIVRAY, Calrossie, Nigg, Ross-shire, **Calrossie Control 255913.**
2nd, No. 703.—JAMES PIPER, The Grange, Burntisland, **Bapton Banner Bearer 268265.**
3rd, No. 705.—J. V. RANK, Delaware, Edenbridge, Kent, **Calrossie Air Control 268880.**

R.N. No. 700.—PETER FORBES JONES, Dunmore Park, Dunmore, Stirlingshire, **Cruggleton Reservist 269670.**

Class 88.—*Shorthorn Bull, born on or between January* 1 *and March* 31, 1935.*

1st, No. 710.—R. WEMYSS HONEYMAN, Ballechin, Strathtay, **Calrossie Silver Wedding 275443.**
2nd, No. 711.—DUNCAN M. STEWART, Millhills, Crieff, **Collynie Era 275914.**
3rd, No. 708.—SIR BERNARD GREENWELL, BT., Marden Park, Woldingham, Surrey, **Marden Snowstorm 2nd, 278338.**

R.N. No. 712.—W. WHITEHEAD, The Hall Farm, Great Hallingbury, Bishops Stortford, **Royal Robin 279588.**

Class 89.—*Shorthorn Bull, born in or between April* 1 *and December* 31, 1935.

1st, No. 718.—J. V. RANK, Delaware, Edenbridge, Kent, **Bapton Leader Royal 274812.**
2nd, No. 716.—R. S. MCWILLIAM, Garguston, Muir of Ord, **Aldsworth Royal Jubilee 274418.**
3rd, No. 714.—G. M. HOPE, Basildon Home Farm, Pangbourne, Berks., **Bapton Realm 274813.**

R.N. No. 715.—MRS. M. C. INGE, Thorpe Hall, Tamworth, **Wing Jubilee 280709.**

Class 90.—*Shorthorn Bull, born on or between January* 1 *and March* 31, 1936.*

1st, No. 727.—W. MCNAIR SNADDEN, The Coldoch, Blair Drummond, Stirling, **Balthayock Grand National 283376.**
2nd, No. 724.—J. V. RANK, Delaware, Edenbridge, Kent, **Bapton Air Control 285606.**
3rd, No. 722.—MRS. W. R. CALVERT, Wetmore, Onibury, Shropshire, **Pittodrie Vulcan 286209.**

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* 1st, 2nd and 3rd Prizes offered by the Shorthorn Society.

4th, No. 723.—William Garne, Aldsworth, Cheltenham, **Scotson Firebrand 285764.**
5th, No. 720.—J. Baird & Co. (Falkirk), Ltd., Bantaskin, Falkirk, **Calrossie Embassy 284421.**

R.N. No. 733.—Lady Wills, Coombe Lodge, Blagdon, Bristol, **Rickford King Bruce 287279.**

Class 91.—*Shorthorn Bull, born on or between April* 1 *and June* 30, 1936.

1st, No. 736.—J. Baird & Co. (Falkirk), Ltd., Bantaskin, Falkirk, **Royal Pride 284460.**
2nd, No. 740.—J. V. Rank, Delaware, Edenbridge, Kent, **Bapton Aerial 285604.**
3rd, No. 741.—W. McNair Snadden, The Coldoch, Blair Drummond, Stirling, **Coldoch Silver Crest 286228.**

R.N. No. 737.—Mrs. W. R. Calvert, Wetmore, Onibury, Shropshire, **Wetmore Adolphus.**

Class 92.—*Shorthorn Bull, born on or between July* 1 *and December* 31, 1936*

1st, No. 744.—William Garne, Aldsworth, Cheltenham, **Aldsworth Primero 282816.**
2nd, No. 749.—Duncan M. Stewart, Millhills, Crieff, **Millhills Solomon 286318.**
3rd, No. 745.—H. & F. B. Hirsch, Low Hall, Aacre, Harrogate, **Dacre Diamond 283400.**

R.N. No. 746.—G. M. Hope, Basildon Home Farm, Pangbourne, Berks., **Bestledune North Star 283555.**

Class 93.—*Shorthorn Cow, in-milk, born in or before* 1933.

1st, No. 753.—J. V. Rank, Delaware, Edenbridge, Kent, 145439 **Bapton Crocus 24th.**
2nd, No. 752.—G. M. Hope, Basildon Home Farm, Pangbourne, Berks., 141993 **Lady Rosemary 25th.**
3rd, No. 751.—Miss A. S. Brocklebank, O.B.E., Wing Grange, Oakham, Rutland, 155786 **Wing Princess Royal 4th.**

Class 94.—*Shorthorn Heifer, in-milk, born in* 1934.

1st, No. 757.—J. V. Rank, Delaware, Edenbridge, Kent, 164839 **Bapton Augusta 11th.**
2nd, No. 755.—F. W. Furness, Pallet Hill, Kirby Knowle, Thirsk, 167748 **Cluny Victoria 4th.**
3rd, No. 754.—Miss A. S. Brocklebank, O.B.E., Wing Grange, Oakham, Rutland, 165438 **Wing Broadhooks 3rd.**

Class 95.—*Shorthorn Heifer, born in* 1935.

1st, No. 761.—James Piper, The Grange, Burntisland, Fife, 181297 **Letham Rothes Queen 2nd.**
2nd, No. 764.—J. V. Rank, Delaware, Edenbridge, Kent, 181479 **Bapton Eliza 7th.**
3rd, No. 759.—Sir Bernard Greenwell, Bt., Marden Park, Woldingham, Surrey, 177809 **Marden Kilblean Beauty.**
4th, No. 765.—W. McNair Snadden, The Coldoch, Blair Drummond, Stirling, 182479 **Coldoch Beauty 2nd.**
5th, No. 760.—R. D. S. Main, The Manor Farm, Elmley Castle, Pershore, Worcs., 180028 **Elmley Golden Princess.**

R.N. No. 763.—J. V. Rank, Delaware, Edenbridge, Kent, 181476 **Bapton Augusta 18th.**

Class 96.—*Shorthorn Heifer, born on or between January* 1 *and March* 31, 1936.

1st, No. 776.—Duncan M. Stewart, Millhills, Crieff, 190750 **Balmerino Iris.**
2nd, No. 774.—Peter Forbes Jones, Dunmore Park, Dunmore, Stirlingshire, 189018 **Larbert Nonpareil 25th.**
3rd, No. 775.—J. V. Rank, Delaware, Edenbridge, Kent, 191624 **Bapton Vanity 2nd.**

R.N. No. 773.—G. M. Hope, Basildon Home Farm, Pangbourne, Berks., 188481 **Bestledune Clipper.**

Class 97.—*Shorthorn Heifer, born on or between April* 1 *and December* 31, 1936.

1st, No. 783.—W. McNair Snadden, The Coldoch, Blair Drummond, Stirling, 192653 **Lavender Lady.**
2nd, No. 784.—Duncan M. Stewart, Millhills, Crieff, 192808 **Millhills Royal Princess 4th.**
3rd, No. 779.—Mrs. W. R. Calvert, Wetmore, Onibury, Shropshire, 187778 **Eccles Augusta 22nd.**

R.N. No. 781.—R. D. S. Main, The Manor Farm, Elmley Castle, Pershore, Worcs., 189999 **Elmley Golden Eliza 3rd.**

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* Prizes offered by the Shorthorn Society.

Herefords.

No. 804.—Perpetual Silver Challenge Trophy for the best Bull and Hereford Herd Book Society's Champion Prize of £10 10*s.* for the best Junior Bull to R. S. DE Q. QUINCEY'S **Vern Nonsuch.**
No. 788.—R.N. for Perpetual Silver Challenge Trophy and Hereford Herd Book Society's Champion Prize of £10 10*s.* for the best Senior Bull to PERCY E. BRADSTOCK'S **Free Town Editor.**
No. 797.—R.N. for Champion Prize for the best Senior Bull to E. G. SHEW & SON'S **Shelderton Hopeful.**
No. 807.—R.N. for Champion Prize for the best Junior Bull to EDWARD WEBB & SONS' **Astwood Dandy.**
No. 844.—Hereford Herd Book Society's Champion Prize of £10 10*s.* for the best Cow or Heifer to RICHARD O. REES' **Phoele Marina.**
No. 838.—R.N. for Champion Prize for the best Cow or Heifer to T. L. D. EVERALL'S **Shraden Violet 2nd.**

Class 98.—*Hereford Bull, born on or before August* 31, 1934.

1st, No. 785.—HIS MAJESTY THE KING, The Royal Farms, Windsor, **Sultan 59367.**
2nd, No. 787.—JOHN FARR, Burton, Ross-on-Wye, **Burton Gladiator 58362.**

Class 99.—*Hereford Bull, born on or between September* 1, 1934, *and August* 31, 1935.

1st, No. 788.—PERCY E. BRADSTOCK, Free Town, Tarrington, Herefordshire, **Free Town Editor 58620.**
2nd, No. 797.—E. G. SHEW & SON, Cold Green, Bosbury, Ledbury, **Shelderton Hopeful 59270.**
3rd, No. 794.—CHARLES H. MORRIS, Weston Court, Pembridge, **Wickton Statesman.**
4th, No. 798.—THOMAS L. WALKER, The Cedars, Broadwas-on-Teme, Worcester, **Ankerdine Conqueror 59624.**
5th, No. 799.—G. WILLIAMS, Hall Farm, Billingsley, Bridgnorth, **Jubilee 60819.**
R.N. No. 791.—JOHN H. EVERALL, Rosapenna, Shrewsbury, **Eyton Elegance 58580.**
H.C. No. 789.

Class 100.—*Hereford Bull, born on or between September* 1 *and November* 30, 1935.*

1st, No. 804.—R. S. DE Q. QUINCEY, The Vern, Bodenham, Hereford, **Vern Nonsuch 60917.**
2nd, No. 807.—EDWARD WEBB & SONS (STOURBRIDGE), LTD., Astwood Farm, Stoke Works, Bromsgrove, **Astwood Dandy 59670.**
3rd, No. 801.—PERCY E. BRADSTOCK, Free Town, Tarrington, Herefordshire, **Free Town Barbarian 60158.**
4th, No. 809.—H. WESTON & SONS, The Bounds, Much Marcle, **Bounds Druid.**
R.N. No. 806.—THOMAS L. WALKER, The Cedars, Broadwas-on-Teme, Worcester, **Ankerdine Anchor.**
H.C. No. 805. **C.** No. 800, 808.

Class 101.—*Hereford Bull, born on or between December* 1, 1935, *and February* 29, 1936.

1st, No. 811.—PERCY E. BRADSTOCK, Free Town, Tarrington, Herefordshire, **Free Town Gladiator 60161.**
2nd, No. 816.—H. R. JENKINS, The Porch, Westhide, Hereford, **Westhide Forecast 60937.**
3rd, No. 813.—L. J. BRERETON, Lower Reule, Gnosall, Stafford, **Aston Lifeguard.**
R.N. No. 814.—H. R. JENKINS, The Porch, Westhide, Hereford, **Westhide Favourite 60935.**
H.C. No. 819. **C.** No. 810.

Class 102.—*Hereford Bull, born on or after March* 1, 1936.

1st, No. 824.—MRS. V. J. HOUGHTON, Harnage, Cressage, Shropshire, **Towy Bendilute 60889.**
2nd, No. 826.—W. E. LOCK, The Town, Castle Frome, Ledbury, **Town Orderly.**
3rd, No. 834.—JOHN WALKER, Knightwick Manor, Worcester, **Knightwick Colombo.**
4th, No. 822.—H. R. GRIFFITHS & SON, Little Tarrington, Herefordshire, **Tarrington Success 60851.**
5th, No. 823.—A. H. HARRINGTON, Mill End, Castle Frome, Ledbury, **Raleigh.**
R.N. No. 828.—JOHN FARR, Burton, Ross-on-Wye, **Burton Invader.**
H.C. Nos. 825, 829. **C.** Nos. 821, 830.

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* 1st, 2nd and 3rd Prizes offered by the Hereford Herd Book Society.

Class 103.—*Hereford Cow or Heifer, in-milk, born on or before August* 31, 1934.

1st, No. 838.—T. L. D. Everall, Shrawardine Castle, Shrewsbury, **Shraden Violet 2nd** (Vol. 63, p. 263).
2nd, No. 836.—The Apley Estates Co., Apley Home Farm, Norton, Shifnal, **Petal** (Vol. 64, p. 272).
3rd, No. 837.—Capt. E. H. Rouse Boughton, Downton Hall, Ludlow, **Downton Hall Pearl** (Vol. 65, p. 191).
R.N. No. 840.—W. E. Lock, The Town, Castle Frome, Ledbury, **Begonia 6th** (Vol. 60, p. 398).

Class 104.—*Hereford Heifer, born on or between September* 1, 1934, *and August* 31, 1935.

1st, No. 844.—Richard O. Rees, Phocle, Ross-on-Wye, **Phocle Marina** (Vol. 66, p. 540).
2nd, No. 843.—F. J. Newman, Wickton Court, Leominster, **Oyster Girl 76th** (Vol. 66, p. 459).
3rd, No. 841.—Capt. E. H. Rouse Boughton, Downton Hall, Ludlow, **Downton Hall Qualm** (Vol. 66, p. 206).
R.N. No. 842.—F. J. Newman, Wickton Court, Leominster, **Gipsy Countess 7th** (Vol. 66, p. 458).
H.C. No. 845.

Class 105.—*Hereford Heifer, born on or between September* 1 *and November* 30, 1935.*

1st, No. 852.—Thomas L. Walker, The Cedars, Broadwas-on-Teme, Worcester, **Ankerdine Puss** (Vol. 67, p. 600).
2nd, No. 846.—A. H. Harrington, Mill End, Castle Frome, Ledbury, **Lilac** (Vol. 67, p. 319).
3rd, No. 849.—John Parr, Burton, Ross-on-Wye, **Peach** (Vol. 67, p. 485).
R.N. No. 850.—Richard O. Rees, Phocle, Ross-on-Wye, **Phocle Pattie** (Vol. 67 p. 539).
C. No. 851.

Class 106.—*Hereford Heifer, born on or after December* 1, 1935.

1st, No. 854.—A. H. Harrington, Mill End, Castle Frome, Ledbury, **Lynette** (Vol. 67, 320).
2nd, No. 858.—James Pryce & Sons, Penmaes, Talgarth, Brecon, **Penmaes Linda** (Vol. 67, p. 525).
3rd, No. 856.—Morgan T. Jones, Sugwas Farm, Hereford, **Sugwas Oyster Pip** (Vol. 67, p. 377).
R.N. No. 855.—Mrs. V. J. Houghton, Harnage, Cressage, Shropshire, **Shrine Marina** (Vol. 66, p. 274).

Devons.

No. 861.—Devon Cattle Breeders' Society's Champion Prize of £10 10*s*. for the best Bull to Abraham Trible & Sons' **Stoke Rubicon.**
No. 860.—R.N. for Champion Prize to Henry Beedell's **Stowey Jack Pot.**
No. 877.—Devon Cattle Breeders' Society's Champion Prize of £10 10*s*. for the best Cow or Heifer to W. J. King's **Climsland Dainty.**
No. 880.—R.N. for Champion Prize to His Majesty the King's **Climsland Daisy 2nd.**

Class 107.—*Devon Bull, born in or before* 1935.

1st, No. 861.—Abraham Trible & Sons, Halsdon, Holsworthy, Devon, **Stoke Rubicon 17015.**
2nd, No. 860.—Henry Beedell, Sydeham, Rackenford, Tiverton, Devon, **Stowey Jack Pot 17020.**
3rd, No. 862.—Fred Yendell & Sons, Wood Barton, Morchard Bishop, Lapford, Devon, **Howard Mill Hussar 16902.**

Class 108.—*Devon Bull, born in* 1936.

1st, No. 866.—Fred Beadle, Stowey Farm, Timberscombe, Minehead, **Stowey Jackal 17788.**
2nd, No. 863.—His Majesty the King, Home Farm, Stoke Climsland, Cornwall, **Climsland Dazzler 17561.**
3rd, No. 868.—W. J. King, Manor Farm, Cothelestone, Taunton, **St. Ivel 17772.**
R.N. No. 865.—Fred Beadle, Stowey Farm, Timberscombe, Minehead, **Stowey Dunkerry 17786.**
H.C. No. 867. C. No. 869.

* Prizes offered by the Hereford Herd Book Society.

Class 109.—*Devon Cow or Heifer, in-milk, born in or before* 1934.

1st, No. 870.—H. H. BROADMEAD, Enmore Castle, Bridgwater, Enmore Lottie 46493.
2nd, No. 873.—ABRAHAM TRIBLE & SONS, Halsdon, Holsworthy, Devon, Halsdon Alice 43793.
3rd, No. 871.—W. J. KING, Manor Farm, Cothelestone, Taunton, Stoke Fairy 43940.
R.N. No. 872.—J. LAURISTON LEWIS, Coombe Cross, Templecombe, Somerset, Temple Lucy 46790.

Class 110.—*Devon Heifer, born in* 1935.

1st, No. 877.—W. J. KING, Manor Farm, Cothelestone, Taunton, Climsland Dainty 47150.
2nd, No. 879.—J. LAURISTON LEWIS, Coombe Cross, Templecombe, Somerset, Temple Hope 47616.
3rd, No. 878.—W. J. KING, Manor Farm, Cothelestone, Taunton, Cothelestone Marigold 47595.
R.N. No. 876.—A. F. CHICHESTER, Chelfham, Barnstaple, Clampit Dainty 15th. 47222.
H.C. No. 875.

Class 111.—*Devon Heifer, born in* 1936.

1st, No. 880.—HIS MAJESTY THE KING, Home Farm, Stoke Climsland, Cornwall, Climsland Daisy 2nd 47961.
2nd, No. 882.—W. J. KING, Manor Farm, Cothelestone, Taunton, Warrens Park Dainty 3rd 48401.
3rd, No. 881.—H. H. BROADMEAD, Enmore Castle, Bridgwater, Enmore Marjery Daw 2nd 48060.
R.N. No. 883.—P. M. WILLIAMS, Stowford, Chittlehampton, Devon, Stowford Daffodil 2nd 48733.

Sussex.

No. 886.—Perpetual Challenge Trophy and Sussex Herd Book Society's Champion Silver Medal for the best Sussex Bull to LORD LECONFIELD'S Petworth Rover 1st.
No. 885.—R.N. for Perpetual Challenge Trophy and Champion Silver Medal to L. O. JOHNSON'S Kings Barn Rover 11th.
No. 888.—Perpetual Challenge Cup for the best Sussex and Sussex Herd Book Society's Champion Silver Medal for the best Cow or Heifer to COL. J. R. WARREN'S Handcross Knelle 3rd.
No. 895.—R.N. for Perpetual Challenge Cup and Champion Silver Medal to L. O. JOHNSON'S Kings Barn Dusky 7th.

Class 112.—*Sussex Bull, born in* 1936.

1st, No. 886.—LORD LECONFIELD, Petworth House, Petworth, Petworth Rover 1st 8207.
2nd, No. 885.—L. O. JOHNSON, Peppers, Ashurst, Steyning, Sussex, Kings Barn Rover 11th 8194.
3rd, No. 884.—BRIG.-GEN. G. HOLDSWORTH, C.B., C.M.G., Glynde Place, Glynde, Sussex, Caburn Imperial 8169.
R.N. No. 887.—COL. J. R. WARREN, O.B.E., M.C., The Hyde, Handcross, Haywards Heath, Handcross Baronet 8234.

Class 113.—*Sussex Cow or Heifer, in-milk, born in or before* 1934.

1st, No. 888.—COL. J. R. WARREN, O.B.E., M.C., The Hyde, Handcross, Haywards Heath, Handcross Knelle 3rd 27483.

Class 114.—*Sussex Heifer, born in* 1935.

1st, No. 893.—COL. J. R. WARREN, O.B.E., M.C., The Hyde, Handcross, Haywards Heath, Handcross Knelle 4th 27758.
2nd, No. 890.—L. O. JOHNSON, Peppers, Ashurst, Steyning, Sussex, Kings Barn Dusky 6th 27682.
3rd, No. 889.—BRIG.-GEN. G. HOLDSWORTH, C.B., C.M.G., Glynde Place, Glynde, Sussex, Caburn Darkey 24th 27636.
R.N. No. 892.—COL. J. R. WARREN, O.B.E., M.C., The Hyde, Handcross, Haywards Heath, Handcross Gipsy 3rd 27755.

Class 115.—*Sussex Heifer, born in* 1936.

1st, No. 895.—L. O. JOHNSON, Peppers, Ashurst, Steyning, Sussex, Kings Barn Dusky 7th 27958.
2nd, No. 897.—COL. J. R. WARREN, O.B.E., M.C., The Hyde, Handcross, Haywards Heath, Handcross Belle 1st 28019.
3rd, No. 894.—BRIG.-GEN. G. HOLDSWORTH, C.B., C.M.G., Glynde Place, Glynde, Sussex, Caburn Gentle 24th 27913.
R.N. No. 896.—LORD LECONFIELD, Petworth House, Petworth, Petworth Gentle 3rd 27966.

Welsh.

No. 898.—Welsh Black Cattle Society's Champion Silver Medal for the best Bull to MOSES GRIFFITH'S **Egryn Buddugol.**
No. 900.—R.N. for Champion Silver Medal to LORD PENRHYN'S **Penrhyn Baron.**
No. 908.—Welsh Black Cattle Society's Champion Silver Medal for the best Cow or Heifer to LORD PENRHYN'S **Calenig 15th of Penrhyn.**
No. 909.—R.N. for Champion Silver Medal to LORD PENRHYN'S **Dorothy 10th of Penrhyn.**
Nos. 900, 908, 909.—Welsh Black Cattle Society's Gold Medal for the best group of one Bull and two Cows or Heifers to LORD PENRHYN'S **Penrhyn Baron, Calenig 15th of Penrhyn and Dorothy 10th of Penrhyn.**
Nos. 907, 916, 917.—R.N. for Gold Medal to MRS. E. H. SPOTTISWOODE'S **Gwern Kentigern, Gwern Lalage and Gwern Lyonesse.**

Class 116.—*Welsh Bull, born on or before November* 30, 1935.

1st, No. 898.—MOSES GRIFFITH, Egryn, Talybont, Merioneth, **Egryn Buddugol 3902.**
2nd, No. 900.—LORD PENRHYN, Penrhyn Castle, Bangor, **Penrhyn Baron 4967.**
3rd, No. 899.—ROBERT JONES, Ty Mawr, Llanfair P.G., Anglesey, **Penywern Comet 4807.**
R.N No. 901.—SIR J. C. E. SHELLEY-ROLLS, BT., Avington, Winchester, **Hendre Gallant 475.**

Class 117.—*Welsh Bull, born on or between December* 1, 1935, *and November* 30, 1936.

1st, No. 904.—MOSES GRIFFITH, Egryn, Talybont, Merioneth, **Egryn Hebogyn.**
2nd, No. 907.—MRS. E. H. SPOTTISWOODE, Rooksnest, Lambourn, Berks., **Gwern Kentigern.**
3rd, No. 905.—SIR J. C. E. SHELLEY-ROLLS, BT., Avington, Winchester, **Avington Jumbo.**

Class 118.—*Welsh Cow or Heifer, in-milk, born on or before November* 30, 1934.

1st, No. 908.—LORD PENRHYN, Penrhyn Castle, Bangor, **Calenig 15th of Penrhyn 11665.**
2nd, No. 909.—LORD PENRHYN, Penrhyn Castle, **Dorothy 10th of Penrhyn 11658.**
3rd, No. 911.—THE HON. LADY SHELLEY-ROLLS, The Hendre, Monmouth, **Grace 11320.**
R.N. No. 910.—THE HON. LADY SHELLEY-ROLLS, The Hendre, **Dream 10884.**

Class 119.—*Welsh Heifer, born on or between December* 1, 1934, *and November* 30, 1936.

1st, No. 917.—MRS. E. H. SPOTTISWOODE, Rooksnest, Lambourn, Berks., **Gwern Lyonesse.**
2nd, No. 912.—MOSES GRIFFITH, Egryn, Talybont, Merioneth, **Egryn Jessie 3rd 13033.**
3rd, No. 915.—THE HON. LADY SHELLEY-ROLLS, The Hendre, Monmouth, **Hendre Flora 13169.**
R.N. No. 916.—MRS. E. H. SPOTTISWOODE, Rooksnest, Lambourn, Berks., **Gwern Lalage.**

Park.

Class 120.—*Park Bull, born in or before* 1935.

1st, No. 918.—THE DUKE OF BEDFORD, K.G., Woburn Abbey, Bletchley, **Woburn Matthias 28th 501.**
2nd, No. 920.—MAJOR Q. E. GURNEY, Bawdeswell Hall, Norfolk, **Bolwick Hermes 539.**
3rd, No. 919.—THE DUKE OF BEDFORD, K.G., Woburn Abbey, Bletchley, **Woburn Mike 2nd 649.**

Class 121.—*Park Cow or Heifer, in-milk, born in or before* 1934.

1st, No. 923.—MAJOR Q. E. GURNEY, Bawdeswell Hall, Norfolk, **Hemblington Black Queen 2198.**
2nd, No. 921.—THE DUKE OF BEDFORD, K.G., Woburn Abbey, Bletchley, **Woburn Buckingham 49th 1766.**
3rd, No. 922.—THE DUKE OF BEDFORD, K.G., Woburn Abbey, **Woburn Buckingham 60th 2370.**
R.N. No. 924.—CAPT. C. G. LANCASTER, Kelmarsh Hall, Northampton, **Kelmarsh Fuchsia 6th 2474.**

Class 122.—*Park Heifer, born in* 1935.

1st, No. 926.—THE DUKE OF BEDFORD, K.G., Woburn Abbey, Bletchley, **Woburn Pam 2594.**
2nd, No. 927.—MAJOR Q. E. GURNEY, Bawdeswell Hall, Norfolk, **Bawdeswell Della 2658.**
3rd, No. 928.—CAPT. C. G. LANCASTER, Kelmarsh Hall, Northampton, **Kelmarsh Poppy 3rd 2748.**
R.N. No. 925.—THE DUKE OF BEDFORD, K.G., Woburn Abbey, Bletchley, **Woburn Chartley 15th 2588.**

Longhorns.

No. 931.—Longhorn Cattle Society's Silver Challenge Cup for the best Senior Longhorn to R. S. WALTER'S Sutton Victor.
No. 938.—R.N. for Silver Challenge Cup to W. E. SWINNERTON'S Crickley Chestnut.
No. 943.—Longhorn Cattle Society's Silver Challenge Cup for the best Junior Longhorn to W. E. SWINNERTON'S Crickley Dewberry.
No. 945.—R.N. for Silver Challenge Cup to R. S. WALTER'S Sutton Special 2nd.

Class 123.—*Longhorn Bull, born in or before* 1935.

1st, No. 931.—R. S. WALTERS, Norfolk Lodge, Sutton Coldfield, Sutton Victor 948.
2nd, No. 929.—T. G. ARNOLD, Ashgrove, Warwick Road, Solihull, Warwickshire, Finham Victor 972.
3rd, No. 930.—T. G. ARNOLD, Solihull, Crickley Forest Lad 981.

Class 124.—*Longhorn Bull, born in* 1936.

1st, No. 934.—W. E. SWINNERTON, Crickley Barrow House, Northleach, Glos., Crickley Peer.
2nd, No. 933.—F. J. MAYO, Friar Waddon, Upwey, Weymouth, Waddon Prince.
3rd, No. 932.—R. R. HOLLICK, Stivichall Grange, Coventry, Finham Victor 2nd.

Class 125.—*Longhorn Cow or Heifer, in-milk, born in or before* 1934.

1st, No. 938.—W. E. SWINNERTON, Crickley Barrow House, Northleach, Glos., Crickley Chestnut (Vol. 17, p. 11).
2nd, No. 939.—W. E. SWINNERTON, Crickley Barrow House, Crickley Ruby (Vol. 19, p. 10).
3rd, No. 935.—F. J. MAYO, Friar Waddon, Upwey, Weymouth, Friar Senorita (Vol. 16, p. 10).
R.N. No. 936.—F. J. MAYO, Friar Waddon, Friar Spite (Vol. 18, p. 7).

Class 126.—*Longhorn Heifer, born in* 1935 *or* 1936.

1st, No. 943.—W. E. SWINNERTON, Crickley Barrow House, Northleach, Glos., Crickley Dewberry (Vol. 19, p. 10).
2nd, No. 945.—R. S. WALTERS, Norfolk Lodge, Sutton Coldfield, Sutton Special 2nd (Vol. 19, p. 12).
3rd, No. 942.—W. E. SWINNERTON, Crickley Barrow House, Northleach, Glos., Crickley Ruby 3rd (Vol. 19, p. 11).
R.N. No. 940.—R. R. HOLLICK, Stivichall Grange, Coventry, Finham Crystal 6th (Vol. 19, p. 7).

Aberdeen-Angus.

No. 946.—Perpetual Challenge Trophy for the best Bull; English Aberdeen-Angus Cattle Association's Gold Medal for the best Animal of opposite sex to winner of Champion Gold Medal; R.N. for Silver Medal for the best Animal bred in England and Wales, to CAPT. F. B. ATKINSON'S Elver of Gallowhill.
No. 972.—R.N. for Perpetual Challenge Trophy and Gold Medal to VISCOUNT ALLENDALE'S Major of Bywell.
No. 997.—Aberdeen-Angus Cattle Society's Champion Gold Medal for the best Aberdeen-Angus and Silver Medal for the best Animal bred in England and Wales, to CAPT. A. L. GOODSON'S Eulima 6th of Kilham.
No. 988.—R.N. for Champion Gold Medal to JAMES BEDDIE'S Gammer Ebenil.
The "Mungoswalls" Silver Challenge Cup for most points awarded in a combination of Aberdeen-Angus entries to CAPT. A. L. GOODSON and LADY ROBINSON (equal points).
R.N. for the "Mungoswalls" Silver Challenge Cup to the MARQUESS OF ZETLAND.

Class 127.—*Aberdeen-Angus Bull, born on or before November* 30, 1934.

1st, No. 946.—CAPT. F. B. ATKINSON, Gallowhill, Morpeth, Northumberland, Elver of Gallowhill 87177.
2nd, No. 957.—LADY ROBINSON, Kirklington Hall, Newark, Kirriemuir of Kirklington 84848.
3rd, No. 948.—LORD CRAWSHAW, Whatton, Loughborough, Per Order 78493.
R.N. No. 959.—THE DUKE OF RUTLAND, Belvoir Castle, Grantham, Erillinder of Bleaton 87349.

Class 128.—*Aberdeen-Angus Bull, born on or between December* 1, 1934, *and November* 30, 1935.

1st, No. 971.—THE MARQUESS OF ZETLAND, G.C.S.I., G.C.I.E., Aske, Richmond, Yorks., Egloss of Sandyknowe 90709.
2nd, No. 968.—LADY ROBINSON, Kirklington Hall, Newark, Jasper Eric of Dereulich 91845.
3rd, No. 963.—A. M. HOLMAN, Hyes, Rudgwick, Sussex, Greker of the Burn 91578.
4th, No. 961.—J. J. CRIDLAN, Maisemore Park, Gloucester, Prince Pike of Maisemore 92790.

Class 129.—*Aberdeen-Angus Bull, born on or between December* 1, 1935, *and November* 30, 1936.

1st, No. 972.—VISCOUNT ALLENDALE, Bywell, Stocksfield-on-Tyne, **Major of Bywell 95879.**
2nd, No. 980.—CAPT. A. L. GOODSON, Kilham, Mindrum, Northumberland, **Eurasian of Kilham 94834.**
3rd, No. 984.—LADY ROBINSON, Kirklington Hall, Newark, **Eagre of Kirklington 94267.**
4th, No. 981.—J. R. HARRISON, The Elms, Bitteswell, Rugby, **Black Marve of Bitteswell 93822.**

R.N. No. 976.—THE EARL OF ELGIN, K.T., C.M.G., Broomhall, Dunfermline, **Epigram of Broomhall 94629.**
H.C. No. 979.

Class 130.—*Aberdeen-Angus Cow or Heifer. in-milk, born on or before November* 30, 1934.

1st, No. 997.—CAPT. A. L. GOODSON, Kilham, Mindrum, Northumberland, **Eulima 6th of Kilham 102652.**
2nd, No. 988.—JAMES BEDDIE, Banks, Strichen, Aberdeenshire, **Gammar Ebenil 104726.**
3rd, No. 995.—CAPT. A. L. GOODSON, Kilham, Mindrum, Northumberland, **Black Briar of Kilham 96606.**
4th, No. 998.—LADY ROBINSON, Kirklington Hall, Newark, **Eyebright of Kirklington 103946.**

H.C. Nos. 986, 991. C. No. 990.

Class 131.—*Aberdeen-Angus Heifer, born on or between December* 1, 1934, *and November* 30, 1935.

1st, No. 1008.—LADY ROBINSON, Kirklington Hall, Newark, **Ilex of Kirklington 110144.**
2nd, No. 1004.—CAPT. A. L. GOODSON, Kilham, Mindrum, Northumberland, **Brazen Maid of Kilham 108707.**
3rd, No. 1005.—A. M. HOLMAN, Hyes, Rudgwick, Sussex, **Miss Betty 3rd of Ballintomb 107705.**
4th, No. 1006.—MRS. F. NAGLE, Conncara, Sulhampstead, Reading, **Eldoma 2nd of Sandyknowe 110526.**

H.C. Nos. 1002, 1007. C. No. 1009.

Class 132.—*Aberdeen-Angus Heifer, born on or between December* 1, 1935, *and November* 30, 1936.

1st, No. 1028.—THE MARQUESS OF ZETLAND, G.C.S.I., G.C.I.E., Aske, Richmond, Yorks., **Aunita of Stonefold 111317.**
2nd, 1011.—VISCOUNT ALLENDALE, Bywell, Stocksfield-on-Tyne, **Mavis of Bywell 110979.**
3rd, No. 1016.—THE EARL OF ELGIN, K.T., C.M.G., Broomhall, Dunfermline, **Black Sadie of Broomhall 111754.**
4th, No. 1025.—LADY ROBINSON, Kirklington Hall, Newark, **Eutheria of Sandyknowe 113912.**
5th, No. 1024.—SIR PRINCE PRINCE-SMITH, BT., Southburn, Driffield, **Iree of Southburn 113408.**

R.N. No. 1023.—LESLIE K. OSMOND, Beelsby, Grimsby, **Melody of Beelsby 113287.**
H.C. Nos. 1013, 1026. C. No. 1012.

Belted Galloways.

No. 1042.—"Knockbrex" Silver Challenge Cup for the best Belted Galloway to the NALO COMPANY'S **Gartmore Dandy 9th.**
No. 1035.—R.N. for "Knockbrex" Silver Challenge Cup to the NALO COMPANY'S **Gartmore Christian 3rd.**

Class 133.—*Belted Galloway Bull, born on or before November* 30, 1936.

1st, No. 1031.—THE NALO COMPANY, LTD., Gartmore, Stirling, **Mark Advocate 1085 B.**
2nd, No. 1029—GEN. SIR IAN HAMILTON, 1, Hyde Park Gardens, London, W.2, **Makerstoun Olly 2nd.**

Class 134.—*Belted Galloway Cow or Heifer, in-milk, born on or before November* 30, 1934.

1st, No. 1035.—THE NALO COMPANY, LTD., Gartmore, Stirling, **Gartmore Christian 3rd 3220 B.**
2nd, No. 1036.—THE NALO COMPANY, LTD., Gartmore, **Gartmore Helen 1st 1822 B.**
3rd, No. 1033.—GEN. SIR IAN HAMILTON, 1, Hyde Park Gardens, London, W.2, **Lullenden Etty 3418 B.**

R.N. No. 1034.—GEN. SIR IAN HAMILTON, 1, Hyde Park Gardens, **Shenley Barbara 1682 B.**

Class 135.—*Belted Galloway Heifer, born on or between December* 1, 1934, *and November* 30, 1935.

1st, No. 1040.—THE NALC COMPANY, LTD., Gartmore, Stirling, **Gartmore Winifred 6th 3462 B.**
2nd, No. 1039.—THE NALC COMPANY, LTD., Gartmore, **Gartmore Mary 8th 3460 B.**
3rd, No. 1038.—GEN. SIR IAN HAMILTON, 1, Hyde Park Gardens, London, W.2, **Makerstoun Biddy 2nd.**
R.N. No. 1037.—GEN. SIR IAN HAMILTON, 1, Hyde Park Gardens, **Lullenden Dainty 3586 B.**

Class 136.—*Belted Galloway Heifer, born on or between December* 1, 1935, *and November* 30, 1936.*

1st, No. 1042.—THE NALC COMPANY, LTD., Gartmore, Stirling, **Gartmore Dandy 9th 3636 B.**
2nd, No. 1041.—GEN. SIR IAN HAMILTON, 1, Hyde Park Gardens, London, W.2, **Lullenden Beauty 2nd 3702 B.**

Galloways.

No. 1043.—"Jubilee" Challenge Cup for best Galloway to WALTER BIGGAR'S **Flashlight of Castlemilk.**
No. 1054.—R.N. for Challenge Cup to ARTHUR B. DUNCAN'S **Ewanston Olive.**

Class 137.—*Galloway Bull, born on or before November* 30, 1936.

1st, No. 1043.—WALTER BIGGAR, Grange Farm, Castle Douglas, **Flashlight of Castlemilk 20114.**
2nd, No. 1044.—ARTHUR B. DUNCAN, Gilchristland, Closeburn, Dumfriesshire, **John S. T. of Blair 18512.**

Class 138.—*Galloway Cow or Heifer, in-milk, born on or before November* 30, 1934.

1st, No. 1047.—R. JARDINE PATERSON, Balgray, Lockerbie, **Gratitude 2nd of Balgray 33025.**
2nd, No. 1046.—W. KENNEDY-MOFFAT, Auchencheyne, Moniaive, Dumfriesshire, **Tibbie 2nd of Lochurr 33753.**

Class 139.—*Galloway Heifer, born on or between December* 1, 1934, and *November* 30, 1935.

1st, No. 1050.—THE GOURLAY FARMING CO., The Ford, Tynron, Dumfriesshire, **Favourite 7th of Kirkland 37302.**
2nd, No. 1052.—R. JARDINE PATERSON, Balgray, Lockerbie, **Judith 2nd of Balgray 37396.**
3rd, No. 1051.—W. KENNEDY-MOFFAT, Auchencheyne, Moniaive, Dumfriesshire, **Louise of Lochurr 37407.**
R.N. No. 1053.—R. JARDINE PATERSON, Balgray, Lockerbie, **Culmark Nannie 2nd 37250.**

Class 140.—*Galloway Heifer, born on or between December* 1, 1935, *and November* 30, 1936.†

1st, No. 1054.—ARTHUR B. DUNCAN, Gilchristland, Closeburn, Dumfriesshire, **Ewanston Olive 38086.**
2nd, No. 1055.—THE GOURLAY FARMING CO., The Ford, Tynron, Dumfriesshire, **Flirt 6th of Kirkland 38130.**
3rd, No. 1058.—R. JARDINE PATERSON, Balgray, Lockerbie, **Florence 3rd of Balgray 38227.**

Highland.

Classes 141 to 143.—*Cancelled under Regulation* 10.

Dairy Shorthorns.

No. 1083.—Shorthorn Society's Champion Prize of £10 for the best Bull to J. HEWSON & SONS' **Lyne Jubilee.**
No. 1061.—R.N. for Champion Prize to LT.-COL. R. W. BARCLAY'S **Buryhill Imperial Bates.**
No. 1170.—Shorthorn Society's Champion Prize of £10 for the best Cow or Heifer to J. TIMBERLAKE & SON'S **Hastoe Barrington 17th.**
No. 1193.—R.N. for Champion Prize to E. J. MANNERS' **Braishfield Sylvia 14th.**
Nos. 1128, 1224, 1251.—"Brackenhurst" Silver Challenge Bowl for the best group of one Bull and two Cows or Heifers to the DUKE OF WESTMINSTER'S **Eaton Diamond, Eaton Lady Ruby 8th** and **Eaton Red Rose 18th.**
Nos. 1121, 1168, 1245.—R.N. for "Brackenhurst" Silver Challenge Cup to MAJOR G. MILLER MUNDY'S **Redrice Mercury, Knells Elliot Fernleaf 2nd** and **Redrice Darling 10th.**

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* Prizes offered by the Dun and Belted Galloway Cattle Breeders' Association.
† Prizes offered by the Galloway Cattle Society.

Nos. 1238,1239, 1240.—Perpetual Silver Challenge Cup for the best group of Three Cows or Heifers by the same sire to HOBBS & DAVIS' **Kelmscott Betty 39th, Kelmscott Primula 215th and Kelmscott Primula 217th.**
Nos. 1222, 1224, 1251.—"Nottingham" Silver Challenge Bowl for the best group of three Cows or Heifers, in-milk, to the DUKE OF WESTMINSTER'S **Eaton Bessie Annetta, Eaton Lady Ruby 8th and Eaton Red Rose 18th.**
Nos. 1238, 1239, 1240.—R.N. for "Nottingham" Silver Challenge Bowl to HOBBS & DAVIS' **Kelmscott Betty 39th, Kelmscott Primula 215th and Kelmscott Primula 217th.**

Class 144.—*Dairy Shorthorn Bull, born in or before* 1934.

1st, No. 1061.—LT.-COL. R. W. BARCLAY, Bury Hill, Dorking, **Buryhill Imperial Bates 262317.**
2nd, No. 1075.—LORD LOCH, Stoke College Street Farm, Stoke-by-Clare, Suffolk, **Stoke College Lord Leicester 266971.**
3rd, No. 1070.—MISS R. M. HARRISON, O.B.E., Maer Hall, Newcastle, Staffs., **Townend Supreme 273852.**
4th, No. 1063.—A. NORMAN CREYKE, Coton Grange, Whixall, Whitchurch, Shropshire, **Greencroft Marquis 257658.**
5th, No. 1076.—A. THOMAS LOYD, Lockinge House, Wantage, **Anderson Wild Bates 9th 241508.**

R.N. No. 1067.—JOHN W. GARDNER, Ivy Farm, Donisthorpe, Burton-on-Trent, **Baskerville Winander 268368.**
H.C. Nos. 1060, 1078, 1079.

Class 145.—*Dairy Shorthorn Bull, born in* 1935.

1st, No. 1083.—J. HEWSON & SONS, Parton, Wigton, Cumberland, **Lyne Jubilee 278283.**
2nd, No. 1086.—E. J. MANNERS, The Old Hall, Netherseale, Burton-on-Trent, **Aikbank Dairy Lord 274367.**
3rd, No. 1084.—W. H. HOLDCROFT, Crowood Farm, Spondon, Derby, **Monogram's Pilate 278531.**
4th, No. 1080.—MR. & MRS. T. R. C. BLOFELD, Hoveton Home Farm, Wroxham, Norfolk, **Hoveton Lord Darlington 277527.**
5th, No. 1087.—HARRY SHILLETO, Golf Links Farm, Tadcaster, **Sizergh Supreme 279862.**

R.N. No. 1091.—G. H. WILLIS, Birdlip, Glos., **Cleasby Wild Warrior 275748.**
H.C. No. 1089. **C.** No. 1090.

Class 146.—*Dairy Shorthorn Bull, born on or between January* 1 *and March* 31, 1936.

1st, No. 1097.—JOHN BARNES, Aikbank, Wigton, Cumberland, **Parton Premier 283328.**
2nd, No. 1108.—G. H. WILLIS, Birdlip, Glos., **Greencroft Bugler 285737.**
3rd, No. 1100.—MAJOR R. F. FULLER, Great Chalfield, Melksham, Wilts., **Chalfield Charming Prince 282745.**
4th, No. 1104.—W. H. VIGUS, Revells Croft, Bengeo, Hertford, **Revels Lord Barrington 2nd 286768.**
5th, No. 1101.—SIR WILLIAM HICKING, BT., Brackenhurst Hall, Southwell, Notts., **Premier of Brackenhurst 283336.**

R.N. No. 1106.—S. WILLIAMSON, Green House, Alveley, Bridgnorth, **Alveley Nelson 287208.**
H.C. No. 1107. **C.** No. 1096.

Class 147.—*Dairy Shorthorn Bull, born on or between April* 1 *and June* 30, 1936.*

1st, No. 1121.—MAJOR G. MILLER MUNDY, Red Rice, Andover, **Redrice Mercury 285089.**
2nd, No. 1124.—T. A. ROSE, Churchill Heath, Kingham, Oxon., **Churchill Mercury 285914.**
3rd, No. 1118.—A. THOMAS LOYD, Lockinge House, Wantage, **Lockinge Chancellor 7th 284266.**
4th, No. 1116.—G. HOWARTH, Pendlebury's Farm, Westhoughton, Bolton, **Calcaria Wild Ambassador 2nd 286112.**
5th, No. 1128.—THE DUKE OF WESTMINSTER, G.C.V.O., D.S.O., Eaton Home Farm, Aldford, Chester, **Eaton Diamond 287013.**

R.N. No. 1119.—E. J. MANNERS, The Old Hall, Netherseale, Burton-on-Trent, **Uldale Baron Monogram 283572.**
H.C. No. 1131. **C.** No. 1115.

Class 148.—*Dairy Shorthorn Bull, born on or between July* 1 *and December* 31, 1936.*

1st, No. 1132.—JOSEPH BARNES, Barugh Syke, Wigton, Cumberland, **Barugh Conqueror 281104.**
2nd, No. 1134.—CHIVERS & SONS, LTD., Histon, Cambridge, **Histon Wild Prince 45th 281844.**

* 1st, 2nd and 3rd Prizes offered by the Shorthorn Society.

3rd, No. 1142.—L. HIGNETT, Hook End Farm, Checkendon, Reading, **Checkendon Imperial Admiral 283347.**
4th, No. 1133.—THE BROGYNTYN ESTATE COMPANY, Brogyntyn, Oswestry, **Brogyntyn Seal 281467.**
5th, No. 1139.—J. DAVIES, Bwlchmawr, Llanwenog, Llanybyther, Cardiganshire, **Pontfaen Star Duke.**
H.C. Nos. 1137, 1144.

Class 149.—*Dairy Shorthorn Cow, in-Calf.**

1st, No. 1146.—CAPT. T. ALLEN-STEVENS, Wicklesham Lodge, Faringdon, Berks., 135338 **Wicklesham Duchess 3rd.**
2nd, No. 1152.—MISS R. M. HARRISON, O.B.E., Maer Hall, Newcastle, Staffs., 147024 **Hill Beauty 7th.**
3rd, No. 1162.—THE DUKE OF WESTMINSTER, G.C.V.O., D.S.O., Eaton Home Farm, Aldford, Chester, 163854 **Eaton Red Rose 17th.**
4th, No. 1158.—E. J. MANNERS, The Old Hall, Netherseale, Burton-on-Trent, 145346 **Baskerville Fashion 2nd.**
5th, No. 1148.—JOSEPH BARNES, Barugh Syke, Wigton, Cumberland, 145493 **Barugh Grey 2nd.**
R.N. No. 1161.—W. H. VIGUS, Revells Croft, Bengeo, Hertford, 124149 **Revels Coronet.**
H.C. Nos. 1149, 1159. C. No. 1153.

Class 150.—*Dairy Shorthorn Cow, in-milk, born in or before* 1930.*

1st, No. 1170.—J. TIMBERLAKE & SON, Hastoe Farm, Tring, 123874 **Hastoe Barrington 17th.**
2nd, No. 1168.—MAJOR G. MILLER MUNDY, Red Rice, Andover, 118071 **Knells Elliot Fernleaf 2nd.**
3rd, No. 1165.—A. THOMAS LOYD, Lockinge House, Wantage, 109970 **Lockinge Leopardess 4th.**
R.N. No. 1166.—SIR EDWARD MANN, BT., Thelveton Hall, Diss, Norfolk, 116010 **Duchess of Barrington 2nd.**

Class 151.—*Dairy Shorthorn Cow, in-milk, born in* 1931.

1st, No. 1176.—LT.-COL. R. W. BARCLAY, Bury Hill, Dorking, 135323 **Fothering Moss Rose 2nd.**
2nd, No. 1174.—CAPT. T. ALLEN-STEVENS, Wicklesham Lodge, Faringdon, Berks., 135340 **Wicklesham Waterloo Molly 2nd.**
3rd, No. 1179.—J. PIERPONT MORGAN, Wall Hall, Aldenham, Watford, 141422 **Aldenham Destiny 11th.**

Class 152.—*Dairy Shorthorn Cow, in-milk, born in* 1932.

1st, No. 1193.—E. J. MANNERS, The Old Hall, Netherseale, Burton-on-Trent, 151676 **Braishfield Sylvia 14th.**
2nd, No. 1191.—SIR EDWARD MANN, BT., Thelveton Hall, Diss, Norfolk, 150719 **Thelveton Lady Wildeye.**
3rd, No. 1190.—A. THOMAS LOYD, Lockinge House, Wantage, 150282 **Lockinge Tulip Leaf 2nd.**
4th, No. 1194.—SIR MARTIN J. MELVIN, BT., Billesley Manor, Alcester, 153795 **Greattew Waterloo Rose 3rd.**
5th, No. 1195.—J. PIERPONT MORGAN, Wall Hall, Aldenham, Watford, 151252 **Aldenham Lady Barrington 2nd.**
R.N. No. 1196.—R. SILCOCK & SONS, LTD., Thornton Hall Farm, Thornton-le-Fylde, Lancs. 153588 **Hastoe Barrington 26th.**
H.C. Nos. 1184, 1197. C. Nos. 1183, 1186.

Class 153.—*Dairy Shorthorn Cow or Heifer, in-milk, born in or after* 1933.

1st, No. 1205.—JOHN CRONK, Skeynes Farm, Edenbridge, Kent, 163475 **Greattew Eve 6th.**
2nd, No. 1224.—THE DUKE OF WESTMINSTER, G.C.V.O., D.S.O., Eaton Home Farm, Aldford, Chester, 163846 **Eaton Lady Ruby 8th.**
3rd, No. 1207.—SIR WILLIAM HICKING, BT., Brackenhurst Hall, Southwell, Notts., 158676 **Brackenhurst Joan.**
4th, No. 1221.—S. A. N. WATNEY, Manor Farm, Catthorpe, Rugby, 163697 **Acryse Red Rose.**
5th, No. 1219.—TUDGE & MAYBERY, Whittingslow, Marsh Brook, Shropshire, 163405 **Whittingslow Podger.**
R.N. No. 1222.—THE DUKE OF WESTMINSTER, G.C.V.O., D.S.O., Eaton Home Farm, Aldford, Chester, 163835 **Eaton Bessie Annetta.**
H.C. Nos. 1202, 1212, 1214, 1220. C. Nos. 1213, 1215, 1216, 1217.

* 1st, 2nd and 3rd Prizes offered by the Shorthorn Society.

Class 154.—*Dairy Shorthorn Heifer, in-milk (to first calving), born in or after* 1934.*

1st, No. 1240.—HOBBS & DAVIS, Kelmscott, Lechlade, Glos., 168495 **Kelmscott Primula 217th.**
2nd, No. 1239.—HOBBS & DAVIS, Kelmscott, 168493 **Kelmscott Primula 215th.**
3rd, No. 1249.—J. TIMBERLAKE & SON, Hastoe Farm, Tring, 173070 **Hastoe Barrington 31st.**
4th, No. 1245.—MAJOR G. MILLER MUNDY, Red Rice, Andover, 170649 **Redrice Darling 10th.**
5th, No. 1230.—JOHN CRONK, Skeynes Farm, Edenbridge, Kent, 173290 **Greattew Princess Carrie 7th.**
R.N. No. 1228.—LT.-COL. E. C. ATKINS, Stretton House, Stretton Baskerville, Hinckley, 166000 **Chevet Sylvia 2nd.**
H.C. Nos. 1242, 1251. C. Nos. 1235, 1237.

Lincolnshire Red Shorthorns.

No. 1254.—Lincolnshire Red Shorthorn Challenge Cup for best Bull to REINHOLD & FRESHNEY'S **Anwick Instructor.**
No. 1259.—R.N. for Challenge Cup to H. GORE BROWNE'S **Coleby Herald.**
No. 1284.—Lincolnshire Red Shorthorn Challenge Cup for best Cow or Heifer to C. L. BEMBRIDGE'S **Anwick Mary.**
No. 1271.—R.N. for Challenge Cup to JOHN EVENS & SON'S **Burton Red Rose 10th.**

Class 155.—*Lincolnshire Red Shorthorn Bull, born in or before* 1935.

1st, No. 1254.—REINHOLD & FRESHNEY, Little Milton, Oxford, **Anwick Instructor 26361.**
2nd, No. 1256.—LEONARD WELLS, The Homestead, North Scarle, Lincoln, **Chetwode Tinker 27059.**
3rd, No. 1255.—E. S. TANSLEY, Willoughby Manor, Alford, Lincs., **Seaholm Bob 6th 26724.**

Class 156.—*Lincolnshire Red Shorthorn Bull, born in* 1936.

1st, No. 1259.—H. GORE BROWNE, Broombriggs, Woodhouse Eaves, Loughborough, **Coleby Herald L 29001.**
2nd, No. 1258.—C. L. BEMBRIDGE, Walcott, Lincoln, **Anwick Monarch L 29097.**
3rd, No. 1257.—C. L. BEMBRIDGE, Walcott, **Anwick Minstrel L 29096.**
R.N. No. 1260.—LEONARD WELLS, The Homestead, North Scarle, Lincoln, **Homestead Prince 24th L 29672.**

Class 157.—*Lincolnshire Red Shorthorn Cow or Heifer, in-milk, born in or before* 1934.†

1st, No. 1264.—E. S. TANSLEY, Willoughby Manor, Alford, Lincs., **Seaholm Dolly (Vol. 40, p. 352).**
2nd, No. 1263.—JOHN EVENS & SON, Burton, Lincoln, **Burton Melton 8th (Vol. 38, p. 236).**
3rd, No. 1261.—S. CECIL ARMITAGE, Lenton Fields, Nottingham, **Lenton Violet (Vol. 40, p. 192).**
R.N. No. 1262.—H. GORE BROWNE, Broombriggs, Woodhouse Eaves, Loughborough, **Broombriggs Wendy (Vol. 39, p. 187).**

Class 158.—*Lincolnshire Red Shorthorn Cow, in-milk, born in or before* 1932, *showing the best milking properties.*

1st, No. 1271.—JOHN EVENS & SON, Burton, Lincoln, **Burton Red Rose 10th (Vol. 39, p. 220).**
2nd, No. 1268.—CHIVERS & SONS, LTD., Histon, Cambridge, **Bendish Charm 20th (Vol. 39, p. 311).**
3rd, No. 1273.—JOHN EVENS & SON, Burton, Lincoln, **Burton Ruby Spot 32nd (Vol. 39, p. 220).**
4th, No. 1270.—CHIVERS & SONS, LTD., Histon, **Histon Fanny 12th (Vol. 39, p. 195).**
R.N. No. 1266.—MRS. J. BOWSER, Nettleham Heath, Lincoln, **Seothern Molly 4th (Vol. 40, p. 210).**

Class 159.—*Lincolnshire Red Shorthorn Cow or Heifer, in-milk, born in or after* 1933, *showing the best milking properties.*†

1st, No. 1280.—F. RUSSELL WOOD, Bendish, Hitchin, Herts., **Bendish Nancy 31st (Vol. 40, p. 363).**
2nd, No. 1278.—JOHN EVENS & SON, Burton, Lincoln, **Burton Royal Starlight 17th (Vol. 40, p. 260).**
3rd, No. 1277.—JOHN EVENS & SON, Burton, **Burton Melton 10th (Vol. 40, p. 258).**
R.N. No. 1281.—F. RUSSELL WOOD, Bendish, Hitchin, Herts., **Bendish Nancy 32nd (Vol. 40, p. 363).**

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* 1st, 2nd and 3rd Prizes offered by the Shorthorn Society.
† Prizes offered by the Lincolnshire Red Shorthorn Association.

Class 160.—*Lincolnshire Red Shorthorn Heifer, born in* 1935.

1st, No. 1284.—C. L. BEMBRIDGE, Walcott, Lincoln, L. 181 **Anwick Mary.**
2nd, No. 1290.—E. S. TANSLEY, Willoughby Manor, Alford, Lincs., L. 1039 **Seaholm Ruth 26th.**
3rd, No. 1288.—J. A. MARSDEN POPPLE, Daneshill, Stevenage, Herts., L. 840 **Castlethorpe Dewdrop 2nd.**
R.N. No. 1287.—H. GORE BROWNE, Broombriggs, Woodhouse Eaves, Loughborough, L. 264 **Broombriggs Connie.**

Class 161.—*Lincolnshire Red Shorthorn Heifer, born in* 1936.

1st, No. 1299.—J. A. MARSDEN POPPLE, Daneshill, Stevenage, Herts., L 1976 **Castlethorpe Dora.**
2nd, No. 1294.—C. L. BEMBRIDGE, Walcott, Lincoln, L 1318 **Anwick Muriel.**
3rd, No. 1296.—H. GORE BROWNE, Broombriggs, Woodhouse Eaves, Loughborough, L 1709 **Broombriggs Dinah.**
4th, No. 1298.—W. DENNIS & SONS, LTD., Kirton, Boston, Lincs., L 1519 **Kirton Greta.**
R.N. No. 1293.—S. CECIL ARMITAGE, Lenton Fields, Nottingham, L 1226 **Lenton Violet 7th.**

South Devons.

No. 1301.—South Devon Herd Book Society's Silver Challenge Cup for the best Bull to J. P. CUNDY & SONS' **Pamflete Buck.**
No. 1303.—R.N. for Silver Challenge Cup to JOHN WAKEHAM & SON'S **Keynedon Sir William.**
No. 1309.—South Devon Herd Book Society's Silver Challenge Cup for the best Cow or Heifer to J. HENDY'S **Alston Lassie 5th.**
No. 1314.—R.N. for Silver Challenge Cup to RICHARD W. CHAFFE'S **Worswell Handsome.**

Class 162.—*South Devon Bull, born in or before* 1935.

1st, No. 1301.—J. P. CUNDY & SONS, Estover Farms, Crownhill, Plymouth, **Pamflete Buck 13345.**
2nd, No. 1303.—JOHN WAKEHAM & SON, Rowden, Newton Ferrers, S. Devon, **Keynedon Sir William 13302.**
3rd, No. 1302.—JOHN A. IRISH, Edmeston, Modbury, S. Devon, **Coleridge No. 121 13229**

Class 163.—*South Devon Bull, born in* 1936.

1st, No. 1306.—RICHARD W. CHAFFE, Worswell Barton, Newton Ferrers, S. Devon, **Worswell Captain 25th 14212.**
2nd, No. 1304.—E. V. BUNDAY, Rydon, Ogwell, Newton Abbot, **Holbeton Laddie 9th 14110.**

Class 164.—*South Devon Cow or Heifer, in-milk, born in or before* 1934.

1st, No. 1309.—J. HENDY, Alston, Holbeton, S. Devon, **Alston Lassie 5th 36333.**
2nd, No. 1308.—JOHN T. DENNIS, Winsor, Yealmpton, Devon, **Winsor Snowdrop 5th 36895.**
3rd, No. 1311.—GEORGE WILLS, Home Farm, Haccombe, Newton Abbot, **Primula 9th 37383.**
R.N. No. 1310.—GEORGE WILLS, Haccombe, **Milkmaid 4th 35940.**

Class 165.—*South Devon Heifer, born in* 1935 *or* 1936.

1st, No. 1314.—RICHARD W. CHAFFE, Worswell Barton, Newton Ferrers, S. Devon, **Worswell Handsome 38550.**
2nd, No. 1313.—E. V. BUNDAY, Rydon, Ogwell, Newton Abbot, **Allenhayes Janis 1st.**
3rd, No. 1315.—JOHN A. IRISH, Edmeston, Modbury, S. Devon, **Edmeston Lily 4th 38760.**

Red Polls.

No. 1320.—Red Poll Cattle Society's Champion Prize of £5 for the best Bull to STUART PAUL'S **Brightwell Peter.**
No. 1319.—R.N. for Champion Prize to MAJOR A. B. MITCHELL'S **Seven Springs Quarry.**
No. 1363.—Red Poll Cattle Society's Champion Prize of £5 for the best Cow or Heifer to LORD CRANWORTH'S **Grundisburgh Good Duck.**
No. 1372.—R.N. for Champion Prize to EXORS. OF WALTER SCRIMGEOUR'S **Wissett Nonsuch.**
Nos. 1333, 1372, 1389.—"Henham" Silver Challenge Cup for the best group of one Bull and two Cows or Heifers to EXORS. OF WALTER SCRIMGEOUR'S **Wissett Red Fox, Wissett Nonsuch and Wissett Please.**
Nos. 1342, 1393, 1408.—R.N. for "Henham" Silver Challenge Cup to STUART PAUL'S **Kirton Panther, Kirton Ruralist and Kirton Ruche.**

Class 166.—*Red Poll Bull, born in or before* 1934.

1st, No. 1320.—STUART PAUL, Kirton Lodge, Ipswich, **Brightwell Peter 16339.**
2nd, No. 1319.—MAJOR A. B. MITCHELL, Poulton Priory, Fairford, Glos., **Seven Springs Quarry 16859.**
3rd, No. 1318.—MRS. G. MEINERTZHAGEN, Theberton House, Leiston, Suffolk, **Morston Hero 16828.**

R.N. No. 1321.—W. R. E. A. UTHWATT, Great Linford Manor, Bletchley, **Latimer Primrose League 17104.**

Class 167.—*Red Poll Bull, born in* 1935.

1st, No. 1323.—J. G. GRAY, Coombe Abbey, Coventry, **Abbeycombe Kentime 17257.**
2nd, No. 1322.—VISCOUNT BLEDISLOE, G.C.M.G., K.B.E., Lydney Park, Glos., **Lydney Majiolini 17454.**
3rd, No. 1333.—EXORS. OF WALTER SCRIMGEOUR, Wissett Hall, Halesworth, Suffolk, **Wissett Red Fox 17588.**
4th, No. 1325.—SIR GUY HAMBLING, BT., Rookery Park, Yoxford, Suffolk, **Yoxford Stormer 17596.**

R.N. No. 1326.—COL. H. E. HAMBRO, C.B.E., Coldham Hall, Bury St. Edmunds, **Coldham Ulysses 17343.**
H.C. No. 1332. C. No. 1328.

Class 168.—*Red Poll Bull, born on or between January* 1 *and May* 31, 1936.

1st, No. 1342.—STUART PAUL, Kirton Lodge, Ipswich, **Kirton Panther 17770.**
2nd, No. 1345.—TREVOR PRICE, Calmsden, Cirencester, **Ciceter Quaker King 2nd.**
3rd, No. 1343.—THE HON. CLIVE PEARSON, Parham, Pulborough, Sussex, **Parham Mango 17849.**
4th, No. 1341.—STUART PAUL, Kirton Lodge, Ispwich, **Kirton Diplomat 17766.**
5th, No. 1344.—TREVOR PRICE, Calmsden, Cirencester, **Ciceter Quaker King.**

R.N. No. 1340.—HERBERT DAVY LONGE, Abbot's Hall, Stowmarket, **Combs Yellow Beacon.**
H.C. No. 1339. C. Nos. 1336, 1338.

Class 169.—*Red Poll Bull, born on or between June* 1 *and December* 31, 1936.*

1st, No. 1353.—THE HON. CLIVE PEARSON, Parham, Pulborough, Sussex, **Parham Murphy.**
2nd, No. 1351.—STUART PAUL, Kirton Lodge, Ipswich, **Kirton Gunner 17767.**
3rd, No. 1350.—MRS. G. MEINERTZHAGEN, Theberton House, Leiston, Suffolk, **Theberton Hero 2nd.**
4th, No. 1346.—LT.-COL. SIR MERRIK R. BURRELL, BT., C.B.E., Knepp Castle Estate Office, Horsham, **Knepp Miser.**

R.N. No. 1347.—SIR GUY HAMBLING, BT., Rookery Park, Yoxford, Suffolk, **Yoxford Pluto 4th 17940.**
H.C. No. 1352. C. No. 1354.

Class 170.—*Red Poll Cow, in-milk, born in or before* 1931.

1st, No. 1363.—LORD CRANWORTH, M.C., Grundisburgh Hall, Woodbridge, **48388 Grundisburgh Good Duck.**
2nd, No. 1372.—EXORS. OF WALTER SCRIMGEOUR, Wissett Hall, Halesworth, Suffolk, **42563 Wissett Nonsuch.**
3rd, No. 1368.—MRS. M. L. GRIFFITH, Little Hallingbury Park, Bishops Stortford, **47277 Hallingbury Ruby 2nd.**
4th, No. 1366.—J. G. GRAY, Coombe Abbey, Coventry, **44526 Abbeycombe Flora.**
5th, No. 1370.—THE HON. CLIVE PEARSON, Parham, Pulborough, Sussex, **47894 Parham Rosie.**

R.N. No. 1361.—MISS M. H. BOUVERIE, O.B.E., Delapre Abbey, Northampton, **46951 Clifton Remembrance.**
H.C. No. 1364. C. No. 1360.

Class 171.—*Red Poll Cow or Heifer, in-milk, born in* 1932 *or* 1933*.

1st, No. 1384.—LADY LODER, Leonardslee, Horsham, **49726 Leonardslee Blackberry.**
2nd, No. 1376.—LT.-COL. SIR MERRIK R. BURRELL, BT., C.B.E., Knepp Castle Estate Office, Horsham, **49665 Knepp Minverva 23rd.**
3rd, No. 1380.—SIR GUY HAMBLING, BT., Rookery Park, Yoxford, Suffolk, **50620 Yoxford Prune 3rd.**
4th, No. 1378.—LT.-COL. SIR MERRIK R. BURRELL, BT., C.B.E., Knepp Castle Estate Office, Horsham, **49672 Knepp Prudence 19th.**
5th, No. 1385.—LADY LODER, Leonardslee, Horsham, **51866 Leonardslee Wild Rose 3rd.**

R.N. No. 1387.—STUART PAUL, Kirton Lodge, Ipswich, **49641 Kirton Oaken.**
H.C. No. 1379. C. No. 1375.

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* 1st, 2nd and 3rd Prizes offered by the Red Poll Cattle Society.

Class 172.—*Red Poll Heifer, in-milk (to first calving), born in* 1934.*

1st, No. 1391.—Lt.-Col. Sir Merrik R. Burrell, Bt., C.B.E., Knepp Castle Estate Office, Horsham, 53943 **Knepp Beryl 7th.**
2nd, No. 1390.—His Majesty the King, Sandringham, Norfolk, 54449 **Royal Iris.**
3rd, No. 1399.—Stuart Paul, Kirton Lodge, Ipswich, 53922 **Kirton Ruralist.**
4th, No. 1400.—Stuart Paul, Kirton Lodge, 53923 **Kirton Setfair.**
5th, No. 1398.—Lady Loder, Leonardslee, Horsham, 54007 **Leonardslee Queensberry 3rd.**
R.N. No. 1395.—Col. H. E. Hambro, C.B.E., Coldham Hall, Bury St. Edmunds, 53255 **Coldham Watsonia.**
H.C. No. 1397. C. No. 1394.

Class 173.—*Red Poll Heifer, born in* 1935.

1st, No. 1405.—J. G. Gray, Coombe Abbey, Coventry, 54954 **Abbeycombe Klint.**
2nd, No. 1408.—Stuart Paul, Kirton Lodge, Ipswich, 56148 **Kirton Ruche.**
3rd, No. 1407.—Sir Guy Hambling, Bt., Rookery Park, Yoxford, Suffolk, 57121 **Yoxford Mavis 6th.**
4th, No. 1406.—Mrs. M. L. Griffith, Little Hallingbury Park, Bishops Stortford, 55864 **Hallingbury Sylvia.**
R.N. No. 1402.—The Trustees of the Condover Estates, Condover, Shrewsbury, 55526 **Condover Daffodil 2nd.**
H.C. No. 1409. C. No. 1403.

Class 174.—*Red Poll Heifer, born in* 1936.

1st, No. 1420.—J. G. Gray, Coombe Abbey, Coventry, 57171 **Arwarton Mimosa 4th.**
2nd, No. 1411.—His Majesty the King, Sandringham, Norfolk, 58854 **Royal Mab.**
3rd, No. 1419.—J. G. Gray, Coombe Abbey, Coventry, 57135 **Abbeycombe Lendesia.**
4th, No. 1412.—His Majesty the King, Sandringham, 58858 **Royal Snowdrop.**
5th, No. 1415.—Viscount Bledisloe, G.C.M.G., K.B.E., Lydney Park, Glos., 58453 **Lydney Babino.**
R.N. No. 1413.—Lt.-Col. R. C. Batt, C.B.E., M.V.O., Gresham Hall, Norwich, 57986 **Gresham Melody.**
H.C. No. 1416. C. No. 1414.

Blue Albions.

No. 1427.—Blue Albion Cattle Society's Silver Challenge Cup for best Bull to John Bassett's **Asherblue Dairyman.**
No. 1429.—R.N. for Challenge Cup to C. H. Goodwin's **Ridgewardine Diadem.**
No. 1439.—Blue Albion Cattle Society's Silver Challenge Cup for best Cow or Heifer to C. H. Goodwin's **Eileen 2nd of Crossfields.**
No. 1449.—R.N. for Challenge Cup to Henry Matthew's **Winterbourne Beauty.**

£75 towards these prizes were offered by the Blue Albion Cattle Society.

Class 175.—*Blue Albion Bull, born in or before* 1935.

1st, No. 1427.—John Bassett, Hill Top Farm, Ashover, Derbyshire, **Asherblue Dairyman 21051.**
2nd, No. 1429.—C. H. Goodwin, Boro Fields, Walton-on-Trent, Burton-on-Trent, **Ridgewardine Diadem.**
3rd, No. 1432.—Charles Henry Webster, Ivonbrook Farm, Grange Mill, Derby, **Ivonbrook Admiral 2001.**
R.N. No. 1428.—W. E. Glover, The Shrubberies, Snarestone, Burton-on-Trent, **Snarestone Fearless.**
H.C. No. 1430.

Class 176.—*Blue Albion Bull, born in* 1936.

1st, No. 1435.—W. E. Glover, The Shrubberies, Snarestone, Burton-on-Trent, **Snarestone Mascot.**
2nd, No. 1437.—Charles Henry Webster, Ivonbrook Farm, Grange Mill, Derby, **Ivonbrook Royal.**
3rd, No. 1433.—John Bassett, Hill Top Farm, Ashover, Derbyshire, **Asherblue Victor.**

Class 177.—*Blue Albion Cow or Heifer, in-milk, born in or before* 1934.

1st, No. 1439.—C. H. Goodwin, Boro Fields, Walton-on-Trent, Burton-on-Trent, **Eileen 2nd of Crossfields**
2nd, No. 1440.—Charles Henry Webster, Ivonbrook Farm, Grange Mill, Derby, **Ivonbrook Jewel.**
3rd, No. 1438.—C. H. Goodwin, Boro Fields, Walton-on-Trent, Burton-on-Trent, **Crystal of Crossfields.**

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* 1st, 2nd and 3rd Prizes offered by the Red Poll Cattle Society.

Class 178.—*Blue Albion Heifer, born in* 1935.

1st, No. 1445.—C. H. GOODWIN, Boro Fields, Walton-on-Trent, Burton-on-Trent, **Crossfields Eva.**
2nd, No. 1446.—CHARLES HENRY WEBSTER, Ivonbrook Farm, Grange Mill, Derby, **Ivonbrook Queenie.**
3rd, No. 1444.—C. H. GOODWIN, Boro Fields, Walton-on-Trent, Burton-on-Trent, **Apricot of Crossfields.**

R.N. No. 1441.—JOHN BASSETT, Hill Top Farm, Ashover, Derbyshire, **Asherblue Nancy.**
H.C. No. 1442. C. No. 1443.

Class 179.—*Blue Albion Heifer, born in* 1936.

1st, No. 1449.—HENRY MATTHEWS, Down Farm, Winterbourne, Bristol, **Winterbourne Beauty.**
2nd, No. 1447.—JOHN BASSETT, Hill Top Farm, Ashover, Derbyshire, **Asherblue Pop.**
3rd, No. 1448.—C. H. GOODWIN, Boro Fields, Walton-on-Trent, Burton-on-Trent, **Crossfields Future Queen.**

British Friesians.

ABBREVIATION.—P.I., Pure imported blood.

No. 1458.—"Mayford" Silver Challenge Trophy, the British Friesian Cattle Society's Champion Prize of £10, for the best Bull, and the "Douneside" Silver Challenge Cup for the best Bull bred by Exhibitor, to MRS. P. TORY'S **Crawford Bestain.**
No. 1466.—R.N. for "Mayford" Silver Challenge Trophy and Champion Prize of £10 to W. G. PLAYER'S **Ednaston Zwarthak.**
No. 1481.—R.N. for "Douneside" Challenge Cup to MRS. GRAHAM REES-MOGG'S **Cliffordchambers Max.**
No. 1504.—British Friesian Cattle Society's Champion Prize of £10 for the best Cow or Heifer to JAMES HOLLINGWORTH'S **Gowrie Marigold.**
No. 1532.—R.N. for Champion Prize to F. W. GILBERT'S **Compton Beauty.**
Nos. 1488, 1489, 1532.—British Friesian Cattle Society's Gold Medal for best group of three Cows or Heifers to F. W. GILBERT'S **Royal Akke 19th, Royal Daffodiz 4th and Compton Beauty.**
Nos. 1543, 1551, 1573.—Perpetual Bronze Challenge Trophy for the best group of three British Friesians, bred by Exhibitor, and R.N. for Gold Medal to the TRUSTEES OF SIR ALASDAIR W. MACROBERT'S **Douneside Lilac, Douneside Fiona 2nd and Douneside Beauty.**
Nos. 1481, 1536, 1565.—R.N. for Perpetual Bronze Challenge Trophy to MRS. GRAHAM REES-MOGG'S **Cliffordchambers Max, Cliffordchambers Kindness and Cliffordchambers Maisie.**

Class 180.—*British Friesian Bull, born in or before* 1934.*

1st, £20. No. 1458.—MRS. P. TORY, Shapwick, Blandford, Dorset, **Crawford Bestain 43667.**
2nd, £15. No. 1455.—G. B. RADCLIFFE, Pool Bank, Tarvin, Cheshire, **Tarvin (imp. 1936) Joost 47155.**
3rd, £10. No. 1452.—W. CURTIS & SON, Berwick Manor, Rainham, Essex, **Barwyke Matrix 43327.**
4th, £4. No. 1456.—LORD RAYLEIGH'S FARMS, The Bury, Hatfield Peverel, Chelmsford, **Terling Collier 44951 P.I.**

R.N. No. 1450.—MRS. C. BAYLEY, Willaston Hall, Nantwich, **Willaston (imp. 1936) Jansadema 47349.**
H.C. No. 1457.

Class 181.—*British Friesian Bull, born on or between January* 1 *and June* 30, 1935.

1st, No. 1466.—WILLIAM G. PLAYER, Whatton Manor, Whatton-in-the-Vale, Notts., **Ednaston Zwarthak 45888.**
2nd, No. 1468.—ALBERT WRIGHTMAN, Middle Herrington Farm, Sunderland, **Herrington (imp. 1936) Leo 46237.**
3rd, No. 1465.—CAPT. I. B. JARMAY, Bulkeley Hall, Malpas, Cheshire, **Bulkeley (imp. 1936) Held 45439.**

R.N. No. 1459.—J. W. SALTER CHALKER, Hinton Farm, Hurst, Twyford, Berks., **Hintonhurst Silver King 46263.**
H.C. Nos. 1460, 1462.

Class 182.—*British Friesian Bull, born on or between July* 1 *and December* 31, 1935.

1st, No. 1469.—MISS HELEN CADELL, Appletree Farm, Osbaldwick, York, **Appletree Marcus 45201.**
2nd, No. 1470.—THE TRUSTEES OF SIR ALASDAIR W. MACROBERT, BT., Douneside, Tarland, Aberdeenshire, **Douneside Lartinique 45843.**

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* 1st, 2nd and 3rd Prizes offered by the British Friesian Cattle Society.

Class 183.—*British Friesian Bull, born on or between January* 1 *and June* 30, 1936.

1st, No. 1481.—Mrs. Graham Rees-Mogg, Clifford Manor, Stratford-on-Avon, **Clifford-chambers Max 47655 P.I.**
2nd, No. 1476.—Ernest B. Hall, Hales Hall, Market Drayton, Shropshire, **Hales Wiseman 47949.**
3rd, No. 1479.—The Trustees of Sir Alasdair W. MacRobert, Bt., Douneside, Tarland, Aberdeenshire, **Douneside Benachie 3rd 47797.**
4th, No. 1471.—G. J. Caddey, Manor Farm, Egham, Surrey, **Lawford Pilot 48085.**
R.N. No. 1472.—Finray Produce, Ltd., Elmer Farm, Finningham, Stowmarket, **Finray Victory 47875.**
H.C. Nos. 1478, 1480. C. Nos. 1475, 1477.

Class 184.—*British Friesian Bull, born on or between July* 1 *and December* 31, 1936.

1st, No. 1482.—J. W. Salter Chalker, Hinton Farm, Hurst, Twyford, Berks., **Hintonhurst Hollander.**
2nd, No. 1483.—Bertram Parkinson, Creskeld Hall, Arthington, Leeds, **Creskeld Joy's Knierke 6th.**

Class 185.—*British Friesian Cow, in-Calf.**

1st, No. 1494.—Albert Weightman, Middle Herrington Farm, Sunderland, **Herrington Maureen 168326.**
2nd, No. 1488.—F. W. Gilbert, The Manor, Chellaston, Derby, **Royal Akke 19th 171864 P.I.**
3rd, No. 1492.—G. B. Radcliffe, Pool Bank, Tarvin, Cheshire, **Tarvin Susette 141878.**
4th, No. 1489.—F. W. Gilbert, The Manor, Chellaston, Derby, **Royal Daffodiz 4th 140970.**
R.N. No. 1490.—W. H. R. Gilbert, The Cottage, Aston Flamville, Hinckley, **Astonville Jeltje 152976 P.I.**
H.C. Nos. 1486, 1493.

Class 186.—*British Friesian Cow, in-milk, born in or before* 1931, *having yielded a minimum of* 8,000 *lb. of milk during a lactation period of* 315 *days.**

1st, £20. No. 1504.—James Hollingworth, Manor Dairy Farm, Coddington, Newark-on-Trent, **Gowrie Marigold 156938.**
2nd, £15. No. 1503.—James Hollingworth, Coddington, **Crawley Honeycomb 155220.**
3rd, £10. No. 1495.—Cecil Ball, Market Place, Oakham, **Ladywood Dainty 4th 148234.**
4th, £4. No. 1506.—G. B. Radcliffe, Pool Bank, Tarvin, Cheshire, **Tarvin Thespis 151668.**
5th, £3. No. 1508.—Strutt & Parker (Farms), Ltd., The Bury, Hatfield Peverel, Chelmsford, **Lavenham Chancery 6th 148420.**
R.N. No. 1500.—W. Curtis & Son, Berwick Manor, Rainham, Essex, **Ingatestone Myrtle Dewdrop 117652.**
H.C. No. 1505.

Class 187.—*British Friesian Cow, in-milk, born in* 1932 *or* 1933, *having yielded a minimum of* 6,500 *lb. of milk during a lactation period of* 315 *days.**

1st, £20. No. 1519.—James Kilpatrick, Craigie Mains, Kilmarnock, **Craigiemains Lady Evelyn 176764.**
2nd, £15. No. 1514.—G. J. Caddey, Manor Farm, Egham, Surrey, **Bethersden Bridget 174980.**
3rd, £10. No. 1525.—Albert Weightman, Middle Herrington Farm, Sunderland, **Herrington Naressa 179298.**
4th, £4. No. 1513.—J. H. Brown, Home Farm, Woodseaves, Stafford, **Marshgreen (imp. 1936) Bet 203338.**
5th, £3. No. 1511.—A. Mead Allen, The Grove, Long Buckby, Rugby, **Longrove Frolic 169654.**
R.N. No. 1517.—F. W. Gilbert, The Manor, Chellaston, Derby, **Hawthorn Portia 168144.**
H.C. No. 1524.

Class 188.—*British Friesian Cow or Heifer, in-milk, born in or after* 1934.*

1st, No. 1532.—F. W. Gilbert, The Manor, Chellaston, Derby, **Compton Beauty 187520.**
2nd, No. 1529.—Thomas Brown, The Grove, Haslington, Crewe, **Quernmore Rosemary 193624.**
3rd, No. 1533.—James Kilpatrick, Craigie Mains, Kilmarnock, **Craigiemains Doris 187756.**
4th, No. 1536.—Mrs. Graham Rees-Mogg, Clifford Manor, Stratford-on-Avon, **Cliffordchambers Kindness 187372.**
R.N. No. 1535—Lord Rayleigh's Farms, The Bury, Hatfield Peverel, Chelmsford, **Terling (imp. 1936) Blomke 6th 206464.**

* 1st, 2nd and 3rd Prizes offered by the British Friesian Cattle Society.

Class 189.—*British Friesian Heifer, born on or between January* 1 *and June* 30, 1935.

1st, No. 1543.—THE TRUSTEES OF SIR ALASDAIR W. MACROBERT, BT., Douneside, Tarland, Aberdeenshire, **Douneside Lilac 199812.**
2nd, No. 1540.—F. W. GILBERT, The Manor, Chellaston, Derby, **Chellaston (imp. 1936) Ytsche 198384.**
3rd, No. 1541.—ERNEST B. HALL, Hales Hall, Market Drayton, Shropshire, **Hales Thora 2nd 201236 P.I.**
4th, No. 1544.—G. B. RADCLIFFE, Pool Bank, Tarvin, Cheshire, **Tarvin Rowena 3rd 206342.**
R.N. No. 1539.—W. CURTIS & SON, Berwick Manor, Rainham, Essex, **Barwyke Butterfly 196958.**

Class 190.—*British Friesian Heifer, born on or between July* 1 *and December* 31, 1935.

1st, No. 1549.—A. J. CREED, Goldicote House, Stratford-on-Avon, **Goldicote Ruth 12th 201014.**
2nd, No. 1551.—THE TRUSTEES OF SIR ALASDAIR W. MACROBERT, BT., Douneside, Tarland, Aberdeenshire, **Douneside Fiona 2nd 199806.**
3rd, No. 1554.—ALBERT WEIGHTMAN, Middle Herrington Farm, Sunderland, **Herrington Paulette 201690.**
R.N. No. 1550.—CAPT. HARRY DOUGLAS, Smedleys Hydropathic Co., Ltd., Matlock, **Farley Eventide 200430.**
H.C. No. 1552.

Class 191.—*British Friesian Heifer, born on or between January* 1 *and June* 30, 1936.*

1st, No. 1562.—G. B. RADCLIFFE, Pool Bank, Tarvin, Cheshire, **Tarvin Berthilda 218620 P.I**
2nd, No. 1565.—MRS. GRAHAM REES-MOGG, Clifford Manor, Stratford-on-Avon, **Cliffordchambers Maisie 210638.**
3rd, No. 1555.—A. J. CREED, Goldicote House, Stratford-on-Avon, **Goldicote Peridot 3rd 212986.**
4th, No. 1561.—WILLIAM G. PLAYER, Whatton Manor, Whatton-in-the-Vale, Notts., **Ednaston Draga 212016 P.I.**
5th, No. 1568.—MISS S. WHITNALL, Hill Farm, East Hanningfield, Chelmsford, **Wheelers Sally 3rd 219874.**
R.N. No. 1559.—THE TRUSTEES OF SIR ALASDAIR W. MACROBERT, BT., Douneside, Tarland, Aberdeenshire, **Douneside Muriel 211828.**
H.C. No. 1564.

Class 192.—*British Friesian Heifer, born on or between July* 1 *and December* 31, 1936.*

1st, No. 1576.—WILLIAM G. PLAYER, Whatton Manor, Whatton-in-the-Vale, Notts., **Ednaston Beechnut 212010.**
2nd, No. 1573.—THE TRUSTEES OF SIR ALASDAIR W. MACROBERT, BT., Douneside, Tarland, Aberdeenshire, **Douneside Beauty 211806.**
3rd, No. 1578.—ALBERT WEIGHTMAN, Middle Herrington Farm, Sunderland, **Herrington Bloom-mijn 213754.**
R.N. No. 1574.—THE TRUSTEES OF SIR ALASDAIR W. MACROBERT, BT., Douneside, Tarland, Aberdeenshire, **Douneside Primrose 211830.**
H.C. No. 1577.

Ayrshires.

No. 1613.—"Cowhill" Silver Challenge Cup for the best Ayrshire to TREVOR GREENSHIELD'S **Barstibly Narcissus 3rd.**
No. 1602.—R.N. for "Cowhill" Challenge Cup to JOHN CLARK'S **Dunrod Susan 5th.**
No. 1659.—"Oldner" Silver Challenge Cup for the best Milk Recorded Cow or Heifer to JOHN CLARK'S **Dunrod Charm 4th.**
No. 1604.—R.N. for "Oldner" Challenge Cup to ALEXANDER COCHRANE'S **Lesserlinn Thrill 2nd.**

Class 193.—*Ayrshire Bull, born before January* 1, 1936.

1st, No. 1583.—HUGH WYLLIE, Minsted, Midhurst, Sussex, **Drumfork Pilot 36008.**
2nd, No. 1588.—DAVID WALLACE, Auchenbrain, Mauchline, Ayrshire, **Barbeigh Revelants 35342.**
3rd, No. 1585.—JOHN LOGAN, Beauchamps, Wyddiall, Buntingford, Herts., **Beauchamps Bursary 34723.**
R.N. No. 1597.—WYNDHAM T. VINT, Thorn Cottage, Wroot, Doncaster, **Millantae What's Wanted 36028.**

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* 1st, 2nd and 3rd Prizes offered by the British Friesian Cattle Society.

Class 194.—*Ayrshire Bull, born on or after January* 1, 1936.

1st, No. 1594.—ADAM W. MONTGOMERIE, Westburn Farm, Cambuslang, Glasgow, **Cowgrove Klondyke 37568.**
2nd, No. 1593.—ADAM W. MONTGOMERIE, Westburn Farm, **Barboigh Special 38032.**
3rd, No. 1592.—JAMES HOWIE & SONS, Muirside, Dumfries, **Crofthead Expectation 37949.**
R.N. No. 1589.—G. W. GREENSHIELDS, Clover-Top, Grindon, Sunderland, **Clover-Top Matador.**

Class 195A.—*Ayrshire Cow, in-milk, born before January* 1, 1934.

1st, No. 1602.—JOHN CLARK, Dunrod Farm, Inverkip, **Dunrod Susan 5th 48174.**
2nd, No. 1599.—JOHN CLARK, Dunrod Farm, **Dunrod Pearl 11th 48169.**
3rd, No. 1622.—D. MACKAY, Symonds Hyde, Hatfield, Herts., **Gree Miss Moffatt 9th 52368**
4th, No. 1603.—ALEXANDER COCHRANE, Nether Craig, Kilmarnock, **Elmhurst Moldavia 45851.**
R.N. No. 1607.—UNIVERSITY OF EDINBURGH (INSTITUTE OF ANIMAL GENETICS), Shothead, Balerno, Midlothian, **Auchenbrain Miss Craig 67th 33760.**

Class 195B.—*Ayrshire Cow, in-calf, born before January* 1, 1934.

1st, No. 1613.—TREVOR GREENSHIELDS, Over-the-Hill, Houghton-le-Spring, Co. Durham **Barstibly Narcissus 3rd 38614.**
2nd, No. 1601.—JOHN CLARK, Dunrod Farm, Inverkip, **Dunrod Snowflake 6th 60759.**
3rd, No. 1627.—ROBERT SILLARS & SON, Ickham Court, Canterbury, **Ickham Bessie 14th 49683.**
4th, No. 1604.—ALEXANDER COCHRANE, Nether Craig, Kilmarnock, **Lesserlinn Thrill 2nd 30522.**
5th, No. 1616.—JAMES HOWIE & SONS, Muirside, Dumfries, **Howie's Blossom 7th 44125**
R.N. No. 1618.—A. & A. KIRKPATRICK, Barr, Sanquhar, **Barr Pansy 43318.**

Class 196A.—*Ayrshire Heifer, in-milk, born on or after January* 1, 1934, *and before January* 1, 1935.*

1st, No. 1637.—ALFRED BARCLAY, Manor Farm, Compton, Newbury, Berks., **Compton Remona 63839.**
2nd, No. 1649.—D. MACKAY, Symonds Hyde, Hatfield, Herts., **Mackay's Prudense.**
3rd, No. 1650.—ADAM W. MONTGOMERIE, Westburn Farm, Cambuslang, Glasgow, **Compton Susan 63842.**
R.N. No. 1653.—WYNDHAM T. VINT, Thorn Cottage, Wroot, Doncaster, **Knockdon Norah 60187.**

Class 196B.—*Ayrshire Heifer, in-calf, born on or after January* 1, 1934, *and before January* 1, 1935.*

1st, No. 1638.—E. BINNS CALDECOTT, Field House Dairy Farm, Houghton-le-Spring, **Houghton Doreen 65809.**
2nd, No. 1640.—JOHN CLARK, Dunrod Farm, Inverkip, **Dunrod Miss 6th 60750.**
3rd, No. 1647.—JAMES HOWIE & SONS, Muirside, Dumfries, **Cauldhame Mayflower 2nd 60158.**
R.N. No. 1646.—ESHOTT PEDIGREE STOCK FARMS, Felton, Northumberland, **Eshott Silvery 63391.**

Class 197.—*Ayrshire Heifer, born in* 1935.

1st, No. 1659.—JOHN CLARK, Dunrod Farm, Inverkip, **Dunrod Charm 4th 65038.**
2nd, No. 1662.—JOHN LOGAN, Beauchamps, Wyddiall, Buntingford, Herts., **Beauchamps Brenda 69064.**
3rd, No. 1666.—W. H. SLATER, Eyton Farm, Wellington, Shropshire, **Finlayston Nessie 67879.**
4th, No. 1660.—W. B. DRONSFIELD, The Manor House, Wilmcote, Stratford-on-Avon, **Finlayston Nerissa 67878.**
5th, No. 1656.—JOHN BOURNE, Snowshill Hill, Moreton-in-Marsh, Glos., **Studley Molly 4th 70874.**
R.N. No. 1655.—JOHN BOURNE, Snowshill Hill, **Burton Ella 69117.**

Class 198.—*Ayrshire Heifer, born in* 1936.*

1st, No. 1669.—ADAM W. MONTGOMERIE, Westburn Farm, Cambuslang, Glasgow, **Lessnessock Nanny Hope 4th 71743.**
2nd, No. 1672.—WYNDHAM T. VINT, Thorn Cottage, Wroot, Doncaster, **Hobsland Lovely 26th.**
3rd, No. 1668.—E. BINNS CALDECOTT, Field House Dairy Farm, Houghton-le-Spring, **Houghton Flower Girl 79495.**

* Prizes offered by the Ayrshire Cattle Herd Book Society.

Guernseys.

No. 1674.—" Calehill " Silver Challenge Cup for the best Bull to R. H. BRITTAIN'S Valentine's Souvenir de Vimiera.
No. 1678.—R.N. for " Calehill " Challenge Cup to ERIC H. ROSE'S Leweston Rose Lad.
No. 1718.—Perpetual Silver Challenge Cup for the best Cow or Heifer and the " Fernhill " Silver Challenge Cup for Cow gaining the highest number of points on Inspection, Milking Trials and Butter Tests to W. DUNKELS' Fernhill Rose 8th.
No. 1722.—R.N. for Perpetual Challenge Cup to ERIC H. ROSE'S Leweston La Belle 3rd.
No. 1710.—R.N. for " Fernhill " Challenge Cup to G. F. DEE SHAPLAND'S Cis of North Valley.
No. 1704.—" Norsebury " Silver Challenge Cup for the Cow in Class 202 gaining a Prize or Commended Card on Inspection and to have gained an " A " Certificate in the Breed Society's Advanced Register in each three successive lactations prior to the closing of entries. The Cup to be awarded to the Cow showing the highest average percentage in Milk and Butterfat over the three lactations, to W. DUNKELS' Fernhill Rose 2nd.

Class 199.—*Guernsey Bull, born in or before* 1934.

1st, No. 1674.—R. H. BRITTAIN, Gulpher Hall Farm, Felixstowe, Valentine's Souvenir de Vimiera 9512.
2nd, No. 1678.—ERIC H. ROSE, Leweston Manor, Sherborne, Dorset, Leweston Rose Lad 7790.
3rd, No. 1679.—ERIC H. ROSE, Leweston Manor, Leweston Rose Lad 6th 10529.
4th, No. 1680.—HORACE H. SCOTT, Hartwell, Hartfield, Sussex, Hartwell Major 10238.
R.N. No. 1676.—SIR W. H. N. GOSCHEN, BT., K.B.E., Durrington House, Harlow, Essex, Durrington May Bird 4th 9915.
H.C. Nos. 1673, 1681.

Class 200.—*Guernsey Bull, born in* 1935.

1st, No. 1683.—MRS. HOWARD PALMER, Heathlands, Wokingham, Berks., Golden Tip's Jewel 2nd of La Houguette 11937.
2nd, No. 1684.—MRS. HOWARD PALMER, Heathlands, Murrell Valor 11433.
3rd, No. 1686.—H. G. SPICER, Homewood, Sawston, Cambridge, Fernhill Robert 19th 11525.
R.N. No. 1682.—THE HON. A. E. GUINNESS, Holmbury House, Holmbury St. Mary, Dorking, Fernhill Kismet 11366.
H.C. No. 1685.

Class 201.—*Guernsey Bull, born in* 1936.

1st, No. 1696.—ERIC H. ROSE, Leweston Manor, Sherborne, Dorset, Leweston Rose Lad 11th 12328.
2nd, No. 1698.—HORACE H. SCOTT, Hartwell, Hartfield, Sussex, Fernhill Robert 21st 12026.
3rd, No. 1693—W. DUNKELS, Fernhill Park, Windsor Forest, Fernhill Kismet 10th 12235.
4th, No. 1701.—CAPT. L. REGINALD WAUD, Bradley Court, Chieveley, Newbury, Bradley Rose Lad 8th 12079.
5th, No. 1690.—R. H. BRITTAIN, Gulpher Hall Farm, Felixstowe, Gulpher Dot's Lad 12194.
R.N. No. 1699.—G. F. DEE SHAPLAND, Green Farm, Claverham, Bristol, Tips Regent of Meadow View 12557.
H.C. Nos. 1700, 1702. C. Nos. 1689, 1691.

Class 202.—*Guernsey Cow, in-milk, born in or before* 1932.

1st, No. 1704.—W. DUNKELS, Fernhill Park, Windsor Forest, 28077 Fernhill Rose 2nd.
2nd, No. 1709.—MRS. HOWARD PALMER, Heathlands, Wokingham, Berks., 31545 Rosey of Goodnestone 46th.
3rd, No. 1715.—MRS. YORKE, Peter's Farm, Lacock, Chippenham, 37496 Peter's Cornelian.
4th, No. 1707.—A. THOMAS LOYD, Lockinge House, Wantage, Berks., 35861 Lockinge Duchess 6th.
5th, No. 1713.—H. B. TURNER, Malverleys, Newbury, Berks., 39223 Flawhatch Kismet's Jasmine 2nd.
R.N. No. 1705.—H. A. Y. DYSON, Dalton, Bolney, Sussex, 38705 Lenore's Polly of Cote Grange.
H.C. Nos. 1706, 1717. C. Nos. 1708, 1710.

Class 203.—*Guernsey Cow or Heifer, in-milk, born in* 1933*

1st, No. 1718.—W. DUNKELS, Fernhill Park, Windsor Forest 41195 Fernhill Rose 8th.
2nd, No. 1722.—ERIC H. ROSE, Leweston Manor, Sherborne, Dorset, 41490 Leweston La Belle 3rd.
3rd, No. 1720.—SIR GORDON LEY, BT., Furze Down, King's Somborne, Hants., 42634 Furze Down Rosey 2nd.
R.N. No. 1719.—H. A. Y. DYSON, Dalton, Bolney, Sussex, 42338, Princess May of Payhay.
H.C. No. 1724.

* Prizes offered by the English Guernsey Cattle Society.

Class 204.—*Guernsey Cow or Heifer, in-milk, born in* 1934.*

1st, No. 1732.—MRS. HOWARD PALMER, Heathlands, Wokingham, Berks., 44723 **Murrell Dower.**
2nd, No. 1733.—ERIC H. ROSE, Leweston Manor, Sherborne, Dorset, 47042 **Leweston Rosey 5th.**
3rd, No. 1726.—W. DUNKELS, Fernhill Park, Windsor Forest, 45417 **Fernhill Starlight 5th.**
4th, No. 1728.—SIR GORDON LEY, BT., Furze Down, King's Somborne, Hants., 45431 **Furze Down Lady Richmond 3rd.**
R.N. No. 1727.—SIR GORDON LEY, BT., Furze Down, 45899 **Furze Down Citron Rose 2nd.**

Class 205.—*Guernsey Heifer, born in* 1935.

1st, No. 1736.—J. BROOKE, Clopton Hall, Wickhambrook, Newmarket, 47166 **Bealings Wild Rose 2nd.**
2nd, No. 1741.—MRS. HOWARD PALMER, Heathlands, Wokingham, Berks, 47949 **Murrell Mildred 11th.**
3rd, No. 1737.—W. DUNKELS, Fernhill Park, Windsor Forest, 47308 **Fernhill Fleur 7th.**
4th, No. 1739.—THE HON. A. E. GUINNESS, Holmbury House, Holmbury St. Mary, Dorking, 47328 **Holmbury Ivy 3rd.**
R.N. No. 1744.—LORD SWAYTHLING, Townhill Park, West End, Southampton, 47467 **Crystal 2nd of Townhill.**
H.C. No. 1738. C. 1742.

Class 206.—*Guernsey Heifer, born in* 1936.

1st, No. 1757.—H. B. TURNER, Malverleys, Newbury, Berks., 51677 **Malverleys May Rose 4th.**
2nd, No. 1761.—CAPT. L. REGINALD WAUD, Bradley Court, Chieveley, Newbury, 50594 **Bradley Spruce 5th.**
3rd, No. 1753.—ERIC H. ROSE, Leweston Manor, Sherborne, Dorset, 52259 **Leweston Wilma 3rd.**
4th, No. 1746.—J. BROOKE, Clopton Hall, Wickhambrook, Newmarket, 51806 **Clopton Rose.**
5th, No. 1760.—CAPT. L. REGINALD WAUD, Bradley Court, Chieveley, Newbury, 52731 **Bradley Gipsy 3rd.**
R.N. No. 1748.—THE HON. A. E. GUINNESS, Holmbury House, Holmbury St. Mary, Dorking, 50624 **Holmbury Myrtle 5th.**
H.C. Nos. 1751, 1752. C. Nos. 1754, 1756.

Jerseys.

No. 1781.—"Meridale" Silver Challenge Cup for the best Yearling Bull from Recorded Dam to R. W. CORNELL'S **Easton Sweep's Beauty.**
No. 1780.—R.N. for "Meridale" Challenge Cup to MRS. G. J. CADDEY'S **Egham Valour.**
English Jersey Cattle Society's Special Prizes for the best Cows or Heifers, in-milk, bred by Exhibitor:—
No. 1868.—1st, £10 to OVALTINE DAIRY FARM'S **Ovaltine Dreaming Lassie.**
No. 1836.—2nd, £5 to W. HUMPHRYS PRESCOTT'S **Gnome's Sweetbread of Highlands.**
No. 1861.—R.N. to LADY HERVEY-BATHURST'S **Somborne Maiden Blonde.**
No. 1763.—English Jersey Cattle Society's Champion Prize of £5 for the best Bull to R. W. CORNELL'S **Ovaltine Wonderful Lad.**
No. 1777.—R.N. for Champion Prize of £5 to the HON. MRS. SMYTH'S **Ashcourt Brave.**
No. 1809.—English Jersey Cattle Society's Champion Prize of £5 for the best Cow or Heifer to MRS. A. M. HALL'S **Design's Fern Oxford Junior's Tamarisk.**
No. 1865.—R.N. for Champion Prize of £5 to M. F. NORTH'S **Vinchelez Sovereign Lady.**
"Conyngham" Silver Challenge Cup for most points awarded in a combination of Jersey entries to OVALTINE DAIRY FARM.
R.N. for "Conyngham" Challenge Cup to M. F. NORTH.

Class 207.—*Jersey Bull, born in or before* 1934.

1st, No. 1763.—R. W. CORNELL, Tedfold, Billingshurst, Sussex, **Ovaltine Wonderful Lad 18353.**
2nd, No. 1764.—J. W. McCALLUM, Grange Farm, Chartridge, Chesham, Bucks., **Samares Cute Prince 19064.**
3rd, No. 1767.—WILLIAM E. PRESS, Wolvers, Reigate, **Wolvers Rufus 17968.**
H.C. Nos. 1762, 1765.

Class 208.—*Jersey Bull, born in* 1935.

1st, No. 1777.—THE HON. MRS. SMYTH, Ashton Court, Long Ashton, Bristol, **Ashcourt Brave 19107.**
2nd, No. 1771.—MRS. A. M. HALL, Shipton Court, Shipton-under-Wychwood, Oxon., **The Mink 19518.**

* 1st, 2nd and 3rd Prizes offered by the English Guernsey Cattle Society.

3rd, No. 1775.—OVALTINE DAIRY FARM, Abbots Langley, Herts., **Ovaltine Liberty's Dream 19420.**
4th, No. 1774.—M. F. NORTH, Loxwood House, Billingshurst, Sussex, **Loxwood Monarch 19369.**
R.N. No. 1773.—H. E. MITCHELL, Great Pellingbridge Farm, Scaynes Hill, Sussex, **Nice Noble Prince 19640.**
H.C. No. 1779. C. No. 1778.

Class 209.—*Jersey Bull, born in* 1936.

1st, No. 1792.—M. F. NORTH, Loxwood House, Billingshurst, Sussex, **Vinchelez Hero.**
2nd, No. 1793.—OVALTINE DAIRY FARM, Abbots Langley, Herts., **Ovaltine Bindleaim 19979.**
3rd, No. 1781.—R. W. CORNELL, Tedfold, Billingshurst, Sussex, **Easton Sweep's Beauty 19783.**
4th, No. 1783.—MRS. HENRY HAWKINS, Everdon Hall, Daventry, **Doreen's Wonderful Prince.**
5th, No. 1782.—MRS. A. M. HALL, Shipton Court, Shipton-under-Wychwood, Oxon., **Shipton Fairy Prince 20039.**
R.N. No. 1780.—MRS. G. J. CADDEY, Manor House, Egham, Surrey, **Egham Valour 19797.**
H.C. No. 1797. C. No. 1786.

Class 210.—*Jersey Cow, in-milk, born in or before* 1933.

1st, No. 1809.—MRS. A. M. HALL, Shipton Court, Shipton-under-Wychwood, Oxon., **(43926) Design's Fern Oxford Junior's Tamarisk.**
2nd, No. 1814.—LT.-COL. J. A. INNES, D.S.O., Horringer Manor, Bury St. Edmunds, **31764 Flossy Fly.**
3rd, No. 1834.—OVALTINE DAIRY FARM, Abbots Langley, Herts, **(44434) Pansy of Oakdale.**
4th, No. 1812.—LADY HERVEY-BATHURST, O.B.E., Somborne Park, Kings Somborne, Hants., **31602 Anduesta.**
5th, No. 1810.—MRS. HENRY HAWKINS, Everdon Hall, Daventry, **13051 Gold Bell.**
R.N. No. 1837.—WILLIAM E. PRESS, Wolvers, Reigate, **27995 Diamond Buckle.**
H.C. Nos. 1802, 1836, 1844. C. No. 1805.

Class 211.—*Jersey Heifer, in-milk, born in* 1934.

1st, No. 1848.—MRS. HENRY HAWKINS, Everdon Hall, Daventry, **32020 Pagari's June Girl.**
2nd, No. 1853.—OVALTINE DAIRY FARM, Abbots Langley, Herts., **22170 Brockwood Iris.**
3rd, No. 1850.—MRS. K. HOLLAS, Parsonage Farm, Highworth, Wilts., **31779 Gentle Yesno.**
4th, No. 1847.—MRS. HENRY HAWKINS, Everdon Hall, Daventry, **31756 Fair Mattie's Design 2nd.**
R.N. No. 1857.—MISS G. M. YULE, Hanstead House, Bricket Wood, St. Albans, **32172 The Poplar's Pride Girl.**
H.C. No. 1852. C. No. 1856.

Class 212.—*Jersey Heifer, in-milk, born in* 1935.*

1st, No. 1865.—M. F. NORTH, Loxwood House, Billingshurst, Sussex, **Vinchelez Sovereign Lady.**
2nd, No. 1868.—OVALTINE DAIRY FARM, Abbots Langley, Herts., **26989 Ovaltine Dreaming Lassie.**
3rd, No. 1861.—LADY HERVEY-BATHURST, O.B.E., Somborne Park, Kings Somborne, Hants., **27351 Somborne Maiden Blonde.**
4th, No. 1870.—WILLIAM E. PRESS, Wolvers, Reigate, **31959 May Queen's Grand-daughter.**
5th, No. 1873.—THE HON. MRS. SMYTH, Ashton Court, Long Ashton, Bristol, **25109 Ashcourt Beauty.**
R.N. No. 1867.—OVALTINE DAIRY FARM, Abbots Langley, Herts., **27002 Ovaltiney.**
H.C. Nos. 1858, 1862. C. Nos. 1871, 1874.

Class 213.—*Jersey Heifer, born in* 1936.

1st, No. 1877.—MRS. HENRY HAWKINS, Everdon Hall, Daventry, **29470 Everdon Fancy's Dream.**
2nd, No. 1881.—H. E. MITCHELL, Great Pellingbridge Farm, Scaynes Hill, Sussex, **30695 Pellingbridge Ambition.**
3rd, No. 1891.—MISS G. M. YULE, Hanstead House, Bricket Wood, St. Albans, **29744 Hanstead Caress.**
4th, No. 1883.—M. F. NORTH, Loxwood House, Billingshurst, Sussex, **30274 Loxwood Bonnie Lass.**
5th, No. 1885.—OVALTINE DAIRY FARM, Abbots Langley, Herts., **30633 Ovaltine Beautiful Lady.**
R.N. No. 1889.—THE HON. MRS. SMYTH, Ashton Court, Long Ashton, Bristol, **28608 Ashcourt Chaplet.**
H.C. Nos. 1884, 1886, 1887. C. Nos. 1878, 1888.

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* **1st, 2nd and 3rd Prizes offered by the English Jersey Cattle Society.**

Kerries.

No. 1895.—British Kerry Cattle Society's Silver Challenge Cup for the best Kerry to H. E. MITCHELL'S Barrington Cactus.
No. 1892.—R.N. for Challenge Cup to LT.-COL. J. A. INNES' Brookwood Egbert.

Class 214.—*Kerry Bull, born in or before* 1936.

1st, No. 1892.—LT.-COL. J. A. INNES, D.S.O., Horringer Manor, Bury St. Edmunds, Brookwood Egbert 963.
2nd, No. 1893.—NEWTON R. STEEL, Hookland Estate, Scaynes Hill, Haywards Heath, Hookland Foreman.

Class 215.—*Kerry Cow, in-milk, born in or before* 1933.

1st. No. 1895.—H. E. MITCHELL, Great Pellingbridge Farm, Scaynes Hill, Sussex, Barrington Cactus 5639.
2nd, No. 1896.—NEWTON R. STEEL, Hookland Estate, Scaynes Hill, Haywards Heath, Hookland Angela 5410.
3rd, No. 1900.—BERTRAM W. A. WATNEY, Brookwood Corner, Holmwood, Surrey, Loran Lady 5714.
R.N. No. 1894.—MR. AND MRS. R. ST. J. BOWEN-COLTHURST, Coolock Dairy Farm, Wakes Colne, Colchester, Buckland Juno 5816.

Class 216.—*Kerry Heifer, in-milk, born in* 1934 *or* 1935.

1st, No. 1902.—NEWTON R. STEEL, Hookland Estate, Scaynes Hill, Haywards Heath, Hookland Eskimo.
2nd, No. 1904.—BERTRAM W. A. WATNEY, Brookwood Corner, Holmwood, Surrey, Brookwood Felicity 5655.
3rd, No. 1903.—BERTRAM W. A. WATNEY, Holmwood, Brookwood Countess 10th 5651.
R.N. No. 1901.—MR. AND MRS. R. ST. J. BOWEN-COLTHURST, Coolock Dairy Farm, Wakes Colne, Colchester, Wadlands Duv Mona 6041.

Dexters.

No. 1921.—Dexter Cattle Society's Silver Challenge Cup for the best Dexter to MRS. ERNEST JOHNSON'S Ashtonhayes Creina.
No. 1906.—R.N. for Challenge Cup to MRS. CARLOS CLARKE'S Ellens Gettysburg.

Class 217.—*Dexter Bull, born in or before* 1935.

1st, No. 1906.—MRS. CARLOS CLARKE, Ellens, Rudgwick, Horsham, Ellens Gettysburg.
2nd, No. 1905.—MRS. C. M. L. CALVERT, Banwell Castle, Banwell, Somerset, Trefonen Jasper 1227.
3rd, No. 1908.—LADY LODER, Leonardslee, Horsham, Chew Tiny Tim 1228.
R.N. No. 1907.—MRS. CARLOS CLARKE, Ellens, Rudgwick, Horsham, Grinstead Waterman 1222.
H.C. No. 1910.

Class 218.—*Dexter Bull, born in* 1936.

1st, No. 1912.—MRS. CARLOS CLARKE, Ellens, Rudgwick, Horsham, Ellens Prodigy.
2nd, No. 1919.—CAPT. JOHN R. STATTER, Castle Morton, Malvern, Castle Morton Bacchus 1215.
3rd, No. 1914.—ROY N. CORNER, The Welling Pedigree Dairy Farm, Hereford, Wellington Regal.
4th, No. 1915.—THE HON. MRS. T. A. EMMET, Amberley Castle, Amberley, Sussex, Amberley Emperor.
R.N. No. 1916.—THE REV. H. A. DOUGLAS MORGAN, Trefonen Rectory, Oswestry, Trefonen Nigger.
H.C. No. 1917.

Class 219.—*Dexter Cow, in-milk, any age.*

1st, No. 1921.—MRS. ERNEST JOHNSON, Ashton Hayes, Chester, Ashtonhayes Creina 4543.
2nd, No. 1923.—LADY LODER, Leonardslee, Horsham, Beenham Dora 4632.
3rd, No. 1920.—MRS. CARLOS CLARKE, Ellens, Rudgwick, Horsham, Grinstead Convolvulus 8th 4590.
R.N. No. 1930.—MRS. T. H. PEYTON, Leeswood Old Hall, Mold, Thorp Dora 4337.
H.C. No. 1924. C. No. 1925.

Class 220.—*Dexter Heifer, in-milk (to first calving), born in* 1934 or 1935.

1st, No. 1935.—LADY LODER, Leonardslee, Horsham, Grinstead Nightingale 15th 4758.
2nd, No. 1934.—MRS. ERNEST JOHNSON, Ashton Hayes, Chester, Ashtonhayes Creina 3rd 4798.
3rd, No. 1931.—MRS. C. M. L. CALVERT, Banwell Castle, Banwell, Somerset, Banwell Maid 2nd 4806.
R.N. No. 1933.—MRS. CARLOS CLARKE, Ellens, Rudgwick, Horsham, Ellens Pottle.

Class 221.—*Dexter Heifer, born in* 1936.*

1st, No. 1941.—MRS. ERNEST JOHNSON, Ashton Hayes, Chester, **Ashtonhayes Creina 4th.**
2nd, No. 1942.—LADY LODER, Leonardslee, Horsham, **Grinstead Dora 2nd 4834.**
3rd, No. 1939.—THE HON. MRS. T. A. EMMET, Amberley Castle, Amberley, Sussex, **Amberley Ebanna.**
4th, No. 1937.—MRS. C. M. L. CALVERT, Banwell Castle, Banwell, Somerset, **Banwell Ruth 2nd.**

R.N. No. 1940.—MRS. ERNEST JOHNSON, Ashton Hayes, Chester, **Ashtonhayes Barbara.**
H.C. No. 1938. C. No. 1945.

Milk Yield Classes.

Class 222.—*Dairy Shorthorn Cows or Heifers.*

1st, No. 1195.—J. PIERPONT MORGAN, Wall Hall, Aldenham, Watford, **Aldenham Lady Barrington 2nd.**
2nd, No. 1179.—J. PIERPONT MORGAN, Wall Hall, **Aldenham Destiny 11th.**

Class 223.—*Lincolnshire Red Shorthorn Cows or Heifers.*

1st, No. 1271.—JOHN EVENS & SON, Burton, Lincoln, **Burton Red Rose 10th.**
2nd, No. 1278.—JOHN EVENS & SON, Burton, **Burton Royal Starlight 17th.**
3rd, No. 1267.—CHIVERS & SONS, LTD., Histon, Cambridge, **Bendish Bride 15th.**
4th, No. 1270.—CHIVERS & SONS, LTD., Histon, **Histon Fanny 12th.**
5th, No. 1266.—MRS. J. BOWSER, Nettleham Heath, Lincoln, **Scothern Molly 4th.**

R.N. No. 1273.—JOHN EVENS & SON, Burton, Lincoln, **Burton Ruby Spot 32nd.**
H.C. No. 1265.

Class 224.—*South Devon Cows or Heifers.*

1st, No. 1308.—JOHN T. DENNIS, Winsor, Yealmpton, Devon, **Winsor Snowdrop 5th.**
2nd, No. 1311.—GEORGE WILLS, Home Farm, Haccombe, Newton Abbot, **Primula 9th.**

Class 225.—*Red Poll Cows or Heifers.*

1st, No. 1375.—MISS M. H. BOUVERIE, O.B.E., Delapre Abbey, Northampton, **Melton Mangrove.**
2nd, No. 1357.—BALCOMBE ESTATES, LTD., Stonehall Farm, Balcombe, Sussex, **Glevering Siskin.**
3rd, No. 1372.—EXORS. OF WALTER SCRIMGEOUR, Wissett Hall, Halesworth, **Wissett Nonsuch.**
4th, No. 1383.—MRS. HENRY D. LEWIS, Combwell Priory, Flimwell, Hawkhurst, **Chipstead Iolaire.**

Class 226.—*Blue Albion Cows or Heifers.*

1st, No. 1438.—C. H. GOODWIN, Boro Fields, Walton-on-Trent, Burton-on-Trent, **Crystal of Crossfields.**
2nd, No. 1440.—C. H. WEBSTER, Ivonbrook Farm, Grange Mill, Derby, **Ivonbrook Jewel.**

Class 227.—*British Friesian Cows or Heifers.*

1st, No. 1519.—JAMES KILPATRICK, Craigie Mains, Kilmarnock, **Craigiemains Lady Evelyn.**
2nd, No. 1497.—J. H. BROWN, Home Farm, Woodseaves, Stafford, **Marshgreen Kathleen.**
3rd, No. 1505.—BERTRAM PARKINSON, Creskeld Hall, Arthington, Leeds, **Creskeld Beatty Honeysuckle 2nd.**
4th, No. 1508.—STRUTT & PARKER (FARMS), LTD., The Bury, Hatfield Peverel, Chelmsford, **Lavenham Chancery 6th.**
5th, No. 1512.—ARTHUR BARBER, Carlton Hall Farm, Worksop, **Chaddesden Mayblob 2nd.**

R.N. No. 1530.—A. J. CREED, Goldicote House, Stratford-on-Avon, **Goldicote (imp. 1936) Steenhuizen.**
H.C. No. 1502.

Class 228.—*Ayrshire Cows or Heifers.*

1st, No. 1631.—W. H. SLATER, Eyton Farm, Wellington, Shropshire, **Findowrie Sonata.**
2nd, No. 1607.—UNIVERSITY OF EDINBURGH (INSTITUTE OF ANIMAL GENETICS), Shothead, Balerno, Midlothian, **Auchenbrain Miss Craig 67th.**
3rd, No. 1630.—ROBERT SILLARS & SON, Ickham Court, Canterbury, **Ickham Juno 4th.**
4th, No. 1609.—UNIVERSITY OF EDINBURGH (INSTITUTE OF ANIMAL GENETICS), Shothead, Balerno, Midlothian, **Balgreddan Nessie.**

Class 229.—*Guernsey Cows or Heifers.*

1st, No. 1714.—MRS. YORKE, Peter's Farm, Lacock, Chippenham, **Peter's Asphodel.**
2nd, No. 1710.—G. F. DEE SHAPLAND, Green Farm, Claverham, Bristol, **Cis of North Valley.**
3rd, No. 1711.—G. F. DEE SHAPLAND, Claverham, **Claverham Daisy.**

* 1st, 2nd and 3rd Prizes offered by the Dexter Cattle Society.

4th, No. 1705.—H. A. Y. Dyson, Dalton, Boiney, Sussex, **Leonore's Polly of Cote Grange.**
5th, No. 1718.—W. Dunkels, Fernhill Park, Windsor Forest, **Fernhill Rose 8th.**
R.N. No. 1703.—Mrs. Joan K. Bateson, Lucas Green Manor, Westend, Chobham, **Esperance 3rd of les Caches.**
H.C. Nos. 1704, 1706, 1713, 1716, 1722, 1723, 1724, 1734.

Class 230.—*Jersey Cows or Heifers.*

1st, No. 1818.—J. W. McCallum, Grange Farm, Chartridge, Chesham, Bucks., **Pearcelands Eileen 10th.**
2nd, No. 1823.—Viscountess Monsell, C.B.E., Dumbleton Hall, Evesham, **Dumbleton Guinea.**
3rd, No. 1817.—A. S. Lockwood, Normanby Hall, Sinnington, York, **Bessie.**
4th, No. 1798.—Miss Marjory G. Barrow, Normanton Hall, Southwell, Notts., **Wheatlands Janie.**
5th, No. 1822.—H. E. Mitchell. Great Pellingbridge Farm, Scaynes Hill, Sussex, **Molly Snowflower 2nd.**
R.N. No. 1816.—Sir John B. Lloyd, Foxbury, Stone Street, Sevenoaks, **Foxbury Valentine 2nd.**
H.C. Nos. 1805, 1808, 1837, 1839.

Class 231.—*Kerry Cows or Heifers.*

No. 1894.—"Elmhurst" Silver Challenge Cup for the Kerry Cow gaining the highest number of points to Mr. and Mrs. R. St. J. Bowen-Colthurst's **Buckland Juno.**
No. 1896.—R.N. for "Elmhurst" Challenge Cup to Newton R. Steel's **Hookland Angela.**
1st, No. 1894.—Mr. and Mrs. R. St. J. Bowen-Colthurst, Coolock Dairy Farm, Wakes Colne, Colchester, **Buckland Juno.**
2nd, No. 1896.—Newton R. Steel, Hookland Estate, Scaynes Hill, Sussex, **Hookland Angela.**

Class 232.—*Dexter Cows or Heifers.*

No. 1930.—Perpetual Silver Challenge Cup for the Dexter Cow gaining the highest number of points to Mrs. T. H. Peyton's **Thorp Dora.**
No. 1923.—R.N. for Challenge Cup to Lady Loder's **Beenham Dora.**

1st, No. 1930.—Mrs. T. H. Peyton, Leeswood Old Hall, Mold, **Thorp Dora.**
2nd, No. 1923.—Lady Loder, Leonardslee, Horsham, **Beenham Dora.**
3rd, No. 1929.—Mrs. T. H. Peyton, Leeswood Old Hall, Mold, **Colomendy Sybil.**
R.N. No. 1920.—Mrs. Carlos Clarke, Ellens, Rudgwick. Horsham, **Grinstead Convolvulus 6th.**

Butter Tests.

No. 1818.—Champion Gold Medal for Cow obtaining the highest number of points in the Butter Tests to J. W. McCallum's **Pearcelands Eileen 10th.**
No. 1823.—R.N. for Champion Gold Medal to Viscountess Monsell's **Dumbleton Guinea.**
English Jersey Cattle Society's Medals for Jersey Cows obtaining the highest number of points:—
No. 1818.—Gold Medal to J. W. McCallum's **Pearcelands Eileen 10th.**
No. 1823.—Silver Medal to Viscountess Monsell's **Dumbleton Guinea.**
No. 1822.—Bronze Medal to H. E. Mitchell's **Molly Sunflower 2nd.**
Certificate of Merit. Nos. 1798, 1805, 1816, 1817, 1839.
English Guernsey Cattle Society's Certificate of Merit. Nos. 1703, 1705, 1713, 1718 and 1734.

Class 233.—*Cow of the Guernsey, Jersey, Kerry or Dexter Breed.*

1st, No. 1818.—J. W. McCallum, Grange Farm, Chartridge, Chesham, Bucks., **Pearcelands Eileen 10th.**
2nd, No. 1823.—Viscountess Monsell, C.B.E., Dumbleton Hall, Evesham, **Dumbleton Guinea.**
3rd, No. 1711.—G. F. Dee Shapland, Green Farm, Claverham, Bristol, **Claverham Daisy.**
4th, No. 1714.—Mrs. Yorke, Peter's Farm, Lacock, Chippenham, **Peter's Asphodel.**
5th, No. 1710.—G. F. Dee Shapland, Green Farm, Claverham, Bristol, **Ols of North Valley.**
R.N. No. 1822.—H. E. Mitchell, Great Pellingbridge Farm, Scaynes Hill, Sussex, **Molly Sunflower 2nd.**
H.C. Nos. 1703, 1705, 1713, 1716, 1718, 1722, 1734, 1798, 1805, 1808, 1816, 1817, 1839.

Class 234.—*Cow of any breed other than those mentioned in Class 233.*

1st, No. 1497.—J. H. Brown, Home Farm, Woodseaves, Stafford, **Marshgreen Kathleen.**
2nd, No. 1271.—John Evens & Son, Burton, Lincoln, **Burton Red Rose 10th.**
3rd, No. 1607.—University of Edinburgh (Institute of Animal Genetics), Shothead, Balerno, Midlothian, **Auchenbrain Miss Craig 67th.**
4th, No. 1508.—Strutt & Parker (Farms), Ltd., The Bury, Hatfield Peverel, Chelmsford, **Lavenham Chancery 6th.**

Goats.

The Prizes for Goats are First, £5; Second, £3; Third, £2; Fourth, £1; Fifth, 10s.

£30 towards these Prizes offered by the British Goat Society.

Special Prizes offered by the British Goat Society:—

No. 1950.—Breed Challenge Certificate for the best Toggenburg Female Goat to MISS M. WINDOW HARRISON'S **Odina of Weald.**
No. 1946.—R.N. for Breed Challenge Certificate to MISS ALEXANDER'S **Stockwell Callay.**
No. 1952.—Breed Challenge Certificate for the best British Toggenburg Female Goat and Challenge Certificate for the best Dual Purpose Goat that has borne a kid to MRS. MORCOM'S **Cornish Praline.**
No. 1948.—R.N. for Breed Challenge Certificate for the best British Toggenburg to MISS E. M. GRESLEY HALL'S **Webb Demeter.**
No. 1953.—Breed Challenge Certificate for the best Saanen Female Goat to MISS K. PARKER'S **Jacynth of Delamere.**
No. 1957.—Breed Challenge Certificate for the best British Saanen Female Goat, Challenge Certificate for the best Female Goat that has borne a kid, and Bronze Medal for the best Female Goat to MISS M. WINDOW HARRISON'S **Hartye of Weald.**
No. 1958.—R.N. for Breed Challenge Certificate to MISS M. WINDOW HARRISON'S **Humble of Weald.**
No. 1963.—The "Chamberlain" Challenge Trophy for the British Saanen Goat gaining the highest number of points in Inspection and Milking to MISS EMILY SKIDMORE'S **Heddon Sandal.**
No. 1960.—R.N. for the "Chamberlain" Challenge Trophy to MRS. MORCOM'S **Cornish Urchinette.**
No. 1969.—Breed Challenge Certificate for the best British Alpine Female Goat, R.N. for Bronze Medal for best Female Goat, and R.N. for Challenge Certificate for the best Female Goat that has borne a kid to J. R. EGERTON'S **Didgemere Darkalette.**
No. 1972.—R.N. for Breed Challenge Certificate for the best British Alpine to MISS M. G. M. MADOC'S **Melverley Marguerite.**
No. 1974.—The "Abbey" Challenge Cup for the British Alpine Goat gaining the highest number of points in Inspection and Milking, and R.N. for Challenge Certificate for the best Dual Purpose Goat that has borne a kid to MISS M. G. M. MADOC'S **Melverley Mistaken.**
No. 1973.—R.N. for the "Abbey" Challenge Cup to MISS M. G. M. MADOC'S **Melverley Merrilees.**
No. 1978.—The "Pomeroy" Challenge Cup for the Anglo-Nubian Goat gaining the highest number of points in the Quality Milking Competition, and Breed Challenge Certificate for the best Anglo-Nubian Female Goat to J. R. EGERTON'S **Malpas Merry.**
No. 1977.—R.N. for the "Pomeroy" Challenge Cup to J. R. EGERTON'S **Malpas Merrilegs.**
No. 1994.—Bronze Medal for the best Goatling to J. R. EGERTON'S **Malpas Matilda.**
No. 1995.—R.N. for Bronze Medal to J. R. EGERTON'S **Malpas Moya.**
The "Dewar" Challenge Cup for the Exhibitor showing a Female Goat in milk, and Goatling:—
Nos. 1957 and 1988.—MISS M. WINDOW HARRISON'S **Hartye of Weald and Humm of Weald.**
R.N. for Challenge Cup, Nos. 1948 and 1999.—MISS E. M. GRESLEY HALL'S **Webb Demeter and Webb Dauphinella.**

Class 235.—*Female Goat, in-milk, any age, entered in or eligible for the Toggenburg Section, or the British Toggenburg Section or Register of the Herd Book.*

1st, No. 1952.—MRS. MORCOM, Clock House, Bromsgrove, **Cornish Praline 161.**
2nd, No. 1948.—MISS E. M. GRESLEY HALL, Chestnut Tree House, Willersey, Broadway, Worcs., **Webb Demeter 158.**
3rd, No. 1950.—MISS M. WINDOW HARRISON, Yewtree Farm, North Weald, Essex, **Odina of Weald 817.**

R.N. No. 1946.—MISS ALEXANDER, Byards Lodge, Knaresborough, **Stockwell Callay 810.**
H.C. No. 1951. C. No. 1947.

Class 236.—*Female Goat, in-milk, any age, entered in or eligible for the Saanen Section of the Herd Book.*

1st, No. 1954.—MISS K. PARKER, Grove House, Tarvin, Chester, **Jean of Delamere 223.**
2nd, No. 1953.—MISS K. PARKER, Tarvin, **Jacynth of Delamere 236.**
3rd, No. 1955.—MISS EMILY SKIDMORE, Ashley Leigh, Box, Wilts., **Heddon Buttercup 202.**

Class 237.—*Female Goat, in-milk, any age, entered in or eligible for the British Saanen Section or Register of the Herd Book.*

1st, No. 1957.—MISS M. WINDOW HARRISON, Yewtree Farm, North Weald, Essex, Hartye of Weald 1049.
2nd, No. 1958.—MISS M. WINDOW HARRISON, Yewtree Farm, Humble of Weald 1050.
3rd, No. 1963.—MISS EMILY SKIDMORE, Ashley Leigh, Box, Wilts., Heddon Sandal 1061.
4th, No. 1961.—MISS K. PARKER, Grove House, Tarvin, Chester, Silver of Delamere 1041.
R.N. No. 1959.—MRS. MORCOM, Clock House, Bromsgrove, Cornish Regardless 378.
H.C. No. 1960.

Class 238.—*Female Goat, in-milk, any age, entered in or eligible for the British Alpine Section or Register of the Herd Book.*

1st, No. 1969.—J. R. EGERTON, Tye House, Bramford, Ipswich, Didgemere Darkalette 1050.
2nd, No. 1972.—MISS M. G. M. MADOC, Saham Toney, Watton, Norfolk, Melverley Marguerite 406.
3rd, No. 1974.—MISS M. G. M. MADOC, Saham Toney, Melverley Mistaken 1081.
4th, No. 1975.—MRS. MORCOM, Clock House, Bromsgrove, Cornish Pitch 233.
R.N. No. 1973.—MISS M. G. M. MADOC, Saham Toney, Melverley Merrilees 378.
H.C. No. 1976.

Class 239.—*Female Goat, in-milk, any age, entered in or eligible for the Anglo-Nubian Section of the Herd Book.*

1st, No. 1978.—J. R. EGERTON, Tye House, Bramford, Ipswich, Malpas Merry 2309.
2nd, No. 1980.—MISS EMILY SKIDMORE, Ashley Leigh, Box, Wilts., Moorhen 2548.
3rd, No. 1977.—J. R. EGERTON, Tye House, Malpas Merrilegs 2423.

Class 240.—*Female Goat, in-milk, any age, any other variety.*

1st, No. 1984.—MRS. MORCOM, Clock House, Bromsgrove, Cornish Playful 11121.
2nd, No. 1982.—MISS E. M. GRESLEY HALL, Chestnut Tree House, Willersey, Broadway, Worcs., Webb Lettice 11553.
3rd, No. 1981.—MISS ALEXANDER, Byards Lodge, Knaresborough, Stockwell Tsuba 12000.
R.N. No. 1983.—MRS. MORCOM, Clock House, Cornish Macedoine 12473.
H.C. No. 1985.

Class 241.—*Goatling, over 1 but not exceeding 2 years old, entered in or eligible for the Saanen Section or the British Saanen Section or Register of the Herd Book.*

1st, No. 1989.—MISS EMILY SKIDMORE, Ashley Leigh, Box, Wilts., Heddon Sandalshoe 1299.
2nd, No. 1988.—MISS M. WINDOW HARRISON, Yewtree Farm, North Weald, Essex, Humm of Weald 1289.

Class 242.—*Goatling, over 1 but not exceeding 2 years old, entered in or eligible for the British Alpine Section or Register of the Herd Book.*

1st, No. 1994.—J. R. EGERTON, Tye House, Bramford, Ipswich, Malpas Matilda 495.
2nd, No. 1993.—J. R. EGERTON, Tye House, Malpas Miriam 1198.
3rd, No. 1991.—MISS ALEXANDER, Byards Lodge, Knaresborough, Stockwell Harpist 506.

Class 243.—*Goatling, over 1 but not exceeding 2 years old, entered in or eligible for the Anglo-Nubian Section of the Herd Book.*

1st, No. 1995.—J. R. EGERTON, Tye House, Bramford, Ipswich, Malpas Moya 2488.
2nd, No. 1996.—J. R. EGERTON, Tye House, Malpas Musette 2489.

Class 244.—*Goatling, over 1 but not exceeding 2 years old, any other variety.*

1st, No. 1997.—J. R. EGERTON, Tye House, Bramford, Ipswich, Malpas Meda 12679.
2nd, No. 1999.—MISS E. M. GRESLEY HALL, Chestnut Tree House, Willersey, Broadway, Worcs., Webb Dauphinella 257.
3rd, No. 2000.—MISS E. M. GRESLEY HALL, Chestnut Tree House, Webb Dauphinette 256.
R.N. No. 2001.—MRS. MORCOM, Clock House, Bromsgrove, Cornish Flame 12606.

Class 245.—*Milk Yield, Quality.*

1st, No. 1952.—MRS. MORCOM, Clock House, Bromsgrove, Cornish Praline.
2nd, No. 1974.—MISS M. G. M. MADOC, Saham Toney, Watton, Norfolk, Melverley Mistaken.
3rd, No. 1973.—MISS M. G. M. MADOC, Saham Toney, Melverley Merrilees.
4th, No. 1948.—MISS E. M. GRESLEY HALL, Chestnut Tree House, Willersey, Broadway, Worcs., Webb Demeter.
5th, No. 1984.—MRS. MORCOM, Clock House, Bromsgrove, Cornish Playful.
R.N. No. 1963.—MISS EMILY SKIDMORE, Ashley Leigh, Box, Wilts., Heddon Sandal.
H.C. Nos. 1978, 1982. C. Nos. 1955, 1972, 1983.

Class 246.—*Milk Yield, Quantity.*

1st, No. 1952.—MRS. MORCOM, Clock House, Bromsgrove, Cornish Praline.
2nd, No. 1973.—MISS M. G. M. MADOC, Saham Toney, Watton, Norfolk, Melverley Merrilees.
3rd, No. 1957.—MISS M. WINDOW HARRISON, Yewtree Farm, North Weald, Essex, Hartye of Weald.
4th, No. 1974.—MISS M. G. M. MADOC, Saham Toney, Watton, Norfolk, Melverley Mistaken.
5th, No. 1948.—MISS E. M. GRESLEY HALL, Chestnut Tree House, Willersey, Broadway, Worcs., Webb Demeter.

R.N. No. 1958.—MISS M. WINDOW HARRISON, Yewtree Farm, North Weald, Essex, Humble of Weald.
H.C. Nos. 1951, 1984. C. Nos. 1963, 1972, 1978, 1982.

SHEEP.

The Prizes for Sheep, unless otherwise stated, are First, £10; Second, £5; Third, £3; Fourth, £2; Fifth, £1.

Oxford Downs.

No. 2005.—"Banbury" Silver Challenge Cup for the best male exhibit and "Birdlip" Silver Challenge Cup for the best exhibit to HUGH WILLIAM STILGOE.
No. 2003.—R.N. for "Banbury" Challenge Cup to HUGH WILLIAM STILGOE.
No. 2038.—"Kelmscott" Silver Challenge Cup for the best female exhibit and R.N. for "Birdlip" Challenge Cup to HOBBS & DAVIS.
No. 2031.—R.N. for "Kelmscott" Challenge Cup to HUGH WILLIAM STILGOE.

Class 247.—*Oxford Down Shearling Ram.*

1st, No. 2005.—HUGH WILLIAM STILGOE, The Grounds, Adderbury, Banbury.
2nd, No. 2003.—HUGH WILLIAM STILGOE, The Grounds, Adderbury, Banbury.
3rd, No. 2008.—G. H. WILLIS, Birdlip, Glos.

R.N. No. 2006.—HUGH WILLIAM STILGOE, The Grounds, Adderbury, Banbury.

Class 248.—*Oxford Down Ram Lamb.*

1st, No. 2013.—E. G. CLIFFORD, Manley Farm, Quenington, Fairford, Glos.
2nd, No. 2018.—W. G. F. WATTS & SONS, Elsfield, Oxford.
3rd, No. 2010.—A. G. BAZLEY, Dean Farm, Hatherop, Fairford, Glos.
4th, No. 2011.—JAMES BUSSON CHESTERMAN, Tuckwells Farm, Kempsford, Fairford, Glos.

R.N. No. 2012.—E. G. CLIFFORD, Manley Farm, Quenington, Fairford, Glos.
H.C. No. 2015.

Class 249.—*Three Oxford Down Ram Lambs.*

1st, No. 2027.—W. F. G. WATTS & SONS, Elsfield, Oxford.
2nd, No. 2025.—HOBBS & DAVIS, Kelmscott, Lechlade, Glos.
3rd, No. 2029.—G. H. WILLIS, Birdlip, Glos.
4th, No. 2023.—E. G. CLIFFORD, Manley Farm, Quenington, Fairford, Glos.

R.N. No. 2024.—W. R. GANTLETT & SON, Manor Farm, Fairford, Glos.
H.C. No. 2020.

Class 250.—*Three Oxford Down Shearling Ewes.*

1st, No. 2031.—HUGH WILLIAM STILGOE, The Grounds, Adderbury, Banbury.
2nd, No. 2030.—A. G. BAZLEY, Dean Farm, Hatherop, Fairford, Glos.
3rd, No. 2033.—G. H. WILLIS, Birdlip, Glos.

Class 251.—*Three Oxford Down Ewe Lambs.*

1st, No. 2038.—HOBBS & DAVIS, Kelmscott, Lechlade, Glos.
2nd, No. 2042.—G. H. WILLIS, Birdlip, Glos.
3rd, No. 2041.—W. F. G. WATTS & SONS, Elsfield, Oxford.
4th, No. 2039.—HUGH WILLIAM STILGOE, The Grounds, Adderbury, Banbury.

R.N. No. 2037.—W. R. GANTLETT & SON, Manor Farm, Fairford, Glos.
H.C. No. 2036.

Shropshires.

No. 2055.—Shropshire Sheep Breeders' Association's Champion Silver Medal for best Ram or Ram Lamb and R.N. for "Hardwicke" Perpetual Silver Challenge Cup to A. E. EVERALL.
No. 2052.—R.N. for Champion Silver Medal to JAMES NORMAN RITCHIE.
No. 2076.—"Hardwicke" Perpetual Silver Challenge Cup for the best exhibit to MISS M. C. INGE.

£15 towards these Prizes offered by the Shropshire Sheep Breeders' Association.

Class 252.—*Shropshire Shearling Ram.*

1st, No. 2052.—JAMES NORMAN RITCHIE, Tern, Wellington, Shropshire.
2nd, No. 2046.—MRS. J. R. CAMPBELL, Hope Farm, Clive, Shropshire.
3rd, No. 2051.—MRS. M. C. INGE, Thorpe Hall, Tamworth.
4th, No. 2049.—A. E. EVERALL, Sherlowe, Wellington, Shropshire.

R.N. No. 2043.—W. BARNETT, Wood Orchard, Audlem, Crewe.
H.C. No. 2050

Class 253.—*Shropshire Ram Lamb.*

1st, No. 2055.—A. E. EVERALL, Sherlowe, Wellington, Shropshire.
2nd, No. 2059.—JAMES NORMAN RITCHIE, Tern, Wellington, Shropshire.
3rd, No. 2054.—A. E. EVERALL, Sherlowe, Wellington, Shropshire.

R.N. No. 2058.—JAMES NORMAN RITCHIE, Tern, Wellington, Shropshire.

Class 254.—*Three Shropshire Shearling Rams.*

1st, No. 2064.—JAMES NORMAN RITCHIE, Tern, Wellington, Shropshire.
2nd, No. 2060.—JOHN M. BELCHER, Tibberton Green, Wellington, Shropshire.
3rd, No. 2063.—MRS. M. C. INGE, Thorpe Hall, Tamworth.

R.N. No. 2062.—A. E. EVERALL, Sherlowe, Wellington, Shropshire.

Class 255.—*Three Shropshire Ram Lambs.*

1st, No. 2069.—JAMES NORMAN RITCHIE, Tern, Wellington, Shropshire.
2nd, No. 2066.—MRS. J. R. CAMPBELL, Hope Farm, Clive, Shropshire.
3rd, No. 2067.—A. E. EVERALL, Sherlowe, Wellington, Shropshire.

R.N. No. 2065.—JOHN M. BELCHER, Tibberton Green, Wellington, Shropshire.

Class 256.—*Three Shropshire Shearling Ewes.*

1st, No. 2076.—MRS. M. C. INGE, Thorpe Hall, Tamworth.
2nd, No. 2077.—JAMES NORMAN RITCHIE, Tern, Wellington, Shropshire.
3rd, No. 2071.—JOHN M. BELCHER, Tibberton Green, Wellington, Shropshire.

R.N. No. 2073.—A. E. EVERALL, Sherlowe, Wellington, Shropshire.

Class 257.—*Three Shropshire Ewe Lambs.*

1st, No. 2081.—A. E. EVERALL, Sherlowe, Wellington, Shropshire.
2nd, No. 2084.—JAMES NORMAN RITCHIE, Tern, Wellington, Shropshire.
3rd, No. 2080.—A. E. EVERALL, Sherlowe, Wellington, Shropshire.

R.N. No. 2079.—JOHN M. BELCHER, Tibberton Green, Wellington, Shropshire.

Southdowns.

No. 2101.—Southdown Sheep Society's Champion Gold Medal for the best Ram or Ram Lamb and R.N for "Northumberland" Perpetual Silver Challenge Cup to LADY LUDLOW.
No. 2086.—R.N. for Champion Gold Medal to JOHN LANGMEAD & SON.
No. 2157.—Southdown Sheep Society's Champion Silver Medal for the best pen of Ewes or Ewe Lambs and the "Northumberland" Perpetual Silver Challenge Cup for the best exhibit to JOHN LANGMEAD & SON.
No. 2159.—R.N. for Champion Silver Medal to LADY LUDLOW.

Class 258.—*Southdown Two-Shear Ram.*

1st, No. 2086.—JOHN LANGMEAD & SON, Northwood, Ford, Arundel, Ford Elect 23810.
2nd, No. 2090.—J. PIERPONT MORGAN, Wall Hall, Aldenham, Watford, Aldenham 302 of 1935 23915.
3rd, No. 2087.—LADY LUDLOW, Luton Hoo, Luton, Luton Hoo 538 of 1935.

R.N. No. 2091.—WILLIAM H. PITTS, Woodhorn, Oving, Chichester, Woodhorn Abbot 23983.

H.C. No. 2092. C. No. 2088.

Class 259.—*Southdown Shearling Ram.*

1st, No. 2101.—LADY LUDLOW, Luton Hoo, Luton.
2nd, No. 2106.—J. PIERPONT MORGAN, Wall Hall, Aldenham, Watford.
3rd, No. 2097.—JOHN LANGMEAD & SON, Northwood, Ford, Arundel.
4th, No. 2096.—HIS MAJESTY THE KING, Sandringham.
5th, No. 2109.—WILLIAM H. PITTS, Woodhorn, Oving, Chichester.

R.N. No. 2095.—THE DUKE OF BEDFORD, K.G., Woburn Abbey, Bletchley.
H.C. No. 2110. C. No. 2098.

Class 260.—*Southdown Ram Lamb.**

1st, No. 2115.—HIS MAJESTY THE KING, Sandringham.
2nd, No. 2119.—JOHN LANGMEAD & SON, Northwood, Ford, Arundel.
3rd, No. 2122.—WILLIAM LEE, Hatch Gate Farm, Wargrave, Berks.
4th, No. 2121.—WALTER LANGMEAD, Wicks Farm, Yapton, Arundel.
5th, No. 2129.—SIR R. SOTHERN-HOLLAND, BT., Westwell Manor, Burford, Oxford.

R.N. No. 2117.—THE EARL OF DERBY, K.G., Hatchfield Farm, Newmarket.
H.C. No. 2120. C. No. 2128.

Class 261.—*Three Southdown Shearling Rams.**

1st, No. 2138.—LADY LUDLOW, Luton Hoo, Luton.
2nd, No. 2140.—J. PIERPONT MORGAN, Wall Hall, Aldenham, Watford.
3rd, No. 2136.—JOHN LANGMEAD & SON, Northwood, Ford, Arundel.
4th, No. 2133.—HIS MAJESTY THE KING, Sandringham.

R.N. No. 2142.—WILLIAM H. PITTS, Woodhorn, Oving, Chichester.
H.C. No. 2143. C. No. 2141.

Class 262.—*Three Southdown Ram Lambs.*

1st, No. 2148.—JOHN LANGMEAD & SON, Northwood, Ford, Arundel.
2nd, No. 2144.—HIS MAJESTY THE KING, Sandringham.
3rd, No. 2152.—J. PIERPONT MORGAN, Wall Hall, Aldenham, Watford.
4th, No. 2146.—THE EARL OF DERBY, K.G., Hatchfield Farm, Newmarket.
5th, No. 2154.—WILLIAM H. PITTS, Woodhorn, Oving, Chichester.

R.N. No. 2149.—WALTER LANGMEAD, Wicks Farm, Yapton, Arundel.
H.C. No. 2150. C. No. 2156.

Class 263.—*Three Southdown Shearling Ewes.*

1st, No. 2157.—JOHN LANGMEAD & SON, Northwood, Ford, Arundel.
2nd, No. 2159.—LADY LUDLOW, Luton Hoo, Luton.
3rd, No. 2161.—J. PIERPONT MORGAN, Wall Hall, Aldenham, Watford.

R.N. No. 2160.—LADY LUDLOW, Luton Hoo, Luton.
H.C. No. 2163. C. No. 2164.

Class 264.—*Three Southdown Ewe Lambs.*

1st, No. 2174.—J. PIERPONT MORGAN, Wall Hall, Aldenham, Watford.
2nd, No. 2170.—JOHN LANGMEAD & SON, Northwood, Ford, Arundel.
3rd, No. 2167.—HIS MAJESTY THE KING, Sandringham.
4th, No. 2171.—WALTER LANGMEAD, Wicks Farm, Yapton, Arundel.
5th, No. 2176.—WILLIAM H. PITTS, Woodhorn, Oving, Chichester.

R.N. No. 2168.—THE EARL OF DERBY, K.G., Hatchfield Farm, Newmarket.
H.C. No. 2173. C. No. 2172.

Hampshire Downs.

No. 2181.—Hampshire Down Sheep Breeders' Association's Champion Prize of £10 for the best exhibit to MAJOR V. S. BLAND.
No. 2198.—R.N. for Champion Prize to P. C. TORY.

Class 265.—*Hampshire Down Shearling Ram.*

1st, No. 2181.—MAJOR V. S. BLAND, The Warren, Aldbourne, Marlborough.
2nd, No. 2184.—E. CLIFTON-BROWN, Burnham Grove, Burnham, Bucks.
3rd, No. 2179.—H. A. BENYON, Englefield House, Englefield, Reading.
4th, No. 2185.—G. M. HOPE, Basildon Home Farm, Pangbourne, Berks., Basildon Renown M.802.

R.N. No. 2182.—MAJOR V. S. BLAND, The Warren, Aldbourne, Marlborough.
H.C. No. 2183. C. No. 2180.

Class 266.—*Hampshire Down Ram Lamb.*

1st, No. 2198.—P. C. TORY, Shapwick, Blandford, Dorset.
2nd, No. 2193.—E. CLIFTON-BROWN, Burnham Grove, Burnham, Bucks.
3rd, No. 2191.—MAJOR V. S. BLAND, The Warren, Aldbourne, Marlborough.
4th, No. 2189.—H. A. BENYON, Englefield House, Englefield, Reading.

R.N. No. 2194.—E. CLIFTON-BROWN, Burnham Grove, Burnham, Bucks.
H.C. No. 2195. C. No. 2196.

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* 1st, 2nd and 3rd Prizes offered by the Southdown Sheep Society.

Class 267.—*Three Hampshire Down Ram Lambs.*

1st, No. 2202.—E. CLIFTON-BROWN, Burnham Grove, Burnham, Bucks.
2nd, No. 2200.—H. A. BENYON, Englefield House, Englefield, Reading.
3rd, No. 2201.—MAJOR V. S. BLAND, The Warren, Aldbourne, Marlborough.

R.N. No. 2206.—P. C. TORY, Shapwick, Blandford, Dorset.
H.C. No. 2205. C. No. 2204.

Class 268.—*Three Hampshire Down Shearling Ewes.*

1st, No. 2207.—E. CLIFTON-BROWN, Burnham Grove, Burnham, Bucks.
2nd, No. 2208.—E. CLIFTON-BROWN, Burnham Grove, Burnham, Bucks.
3rd, No. 2209.—W. TODD, Little Ponton Grange, Grantham.

Class 269.—*Three Hampshire Down Ewe Lambs.*

1st, No. 2211.—MAJOR V. S. BLAND, The Warren, Aldbourne, Marlborough.
2nd, No. 2212.—E. CLIFTON-BROWN, Burnham Grove, Burnham, Bucks.
3rd, No. 2214.—A. THOMAS LOYD, Lockinge House, Wantage.

R.N. No. 2210.—H. A. BENYON, Englefield House, Englefield, Reading.
H.C. No. 2215. C. No. 2213.

Suffolks.

No. 2245.—Suffolk Sheep Society's Perpetual Challenge Plate and £5 for the best exhibit to J. R. KEEBLE & SON.
No. 2223.—R.N. for Perpetual Challenge Plate to STUART PAUL.
"Southburn" Silver Challenge Cup for the most points awarded in a combination of entries in the Suffolk Sheep Classes to JOHN R. KEEBLE & SON.
R.N. for Silver Challenge Cup to STUART PAUL.

Class 270.—*Suffolk Two-Shear Ram.*

1st, No. 2218.—JOHN R. KEEBLE & SON, Brantham Hall, Manningtree, Essex, Brantham Lampard B. 24583.
2nd, No. 2219—STUART PAUL, Kirton Lodge, Ipswich, Kirton Jonathan 24666.
3rd, No. 2217.—JOHN R. KEEBLE & SON, Brantham Hall, Brantham Trumpington 24108.

R.N. No. 2216.—HOLLESLEY FARM, Hollesley, Woodbridge, Brantham Double Six 24135.

Class 271.—*Suffolk Shearling Ram.*

1st, No. 2223.—STUART PAUL, Kirton Lodge, Ipswich, Kirton New John.
2nd, No. 2221.—HOLLESLEY FARM, Hollesley, Woodbridge.
3rd, No. 2222.—JOHN R. KEEBLE & SON, Brantham Hall Manningtree, Essex.

R.N. No. 2225.—SIR PRINCE PRINCE-SMITH, BT., Southburn, Driffield.

Class 272.—*Suffolk Ram Lamb.*

1st, No. 2234.—STUART PAUL, Kirton Lodge, Ipswich.
2nd, No. 2233.—J. R. KEEBLE & SON, Brantham Hall, Manningtree, Essex.
3rd, No. 2235.—STUART PAUL, Kirton Lodge, Ipswich.
4th, No. 2228.—THE EARL OF ELLESMERE, Stetchworth Park, Newmarket.
5th, 2239.—FRANK SAINSBURY, Blunts Hall, Little Wratting, Haverhill.

R.N. No. 2232.—J. R. KEEBLE & SON, Brantham Hall, Manningtree, Essex.

Class 273.—*Three Suffolk Ram Lambs.**

1st, No. 2245.—J. R. KEEBLE & SON, Brantham Hall, Manningtree, Essex.
2nd, No. 2246.—STUART PAUL, Kirton Lodge, Ipswich.
3rd, No. 2241.—THE EARL OF ELLESMERE, Stetchworth Park, Newmarket.

R.N. No. 2242.—HOLLESLEY FARM, Hollesley, Woodbridge.

Class 274.—*Three Suffolk Shearling Ewes.*

1st, No. 2249.—HOLLESLEY FARM, Hollesley, Woodbridge.
2nd, No. 2251.—STUART PAUL, Kirton Lodge, Ipswich.
3rd, No. 2250.—J. R. KEEBLE & SON, Brantham Hall, Manningtree, Essex.

R.N. No. 2252.—SIR PRINCE PRINCE-SMITH, BT., Southburn, Driffield.

Class 275.—*Three Suffolk Ewe Lambs.*

1st, No. 2255.—J. R. KEEBLE & SON, Brantham Hall, Manningtree, Essex.
2nd, No. 2256.—STUART PAUL, Kirton Lodge, Ipswich.
3rd, No. 2254.—HOLLESLEY FARM, Hollesley, Woodbridge.

R.N. No. 2253.—THE EARL OF ELLESMERE, Stetchworth Park, Newmarket.

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* Prizes offered by the Suffolk Sheep Society.

Dorset Downs.

No. 2274.—Dorset Down Sheep Breeders' Association's Champion Prize of 10 guineas for the best exhibit to FREDK. W. SURRIDGE.
No. 2271.—R.N. for Champion Prize to P. & C. SEWARD.

Class 276.—*Dorset Down Ram, Shearling and upwards.*

1st, No. 2266.—FREDK. W. SURRIDGE, Mucking, Stanford-le-Hope, Essex.
2nd, No. 2261.—JOHN STRANG, Bere Regis, Wareham, Dorset.
3rd, No. 2263.—FREDK. W. SURRIDGE, Mucking, Stanford-le-Hope, Essex.
R.N. No. 2265.—FREDK. W. SURRIDGE, Mucking, Stanford-le-Hope, Essex.

Class 277.—*Dorset Down Ram Lamb.**

1st, No. 2274.—FREDK. W. SURRIDGE, Mucking, Stanford-le-Hope, Essex.
2nd, No. 2271.—P. & C. SEWARD, Weston, Petersfield, Hants.
3rd, No. 2275.—FREDK. W. SURRIDGE, Mucking, Stanford-le-Hope, Essex.
4th, No. 2270.—HOOPER BROS., Newburgh, Winfrith, Dorchester.
R.N. No. 2273.—JOHN STRANG, Bere Regis, Wareham, Dorset.

Class 278.—*Dorset Down Shearling Ewe.*

1st, No. 2278.—JOHN STRANG, Bere Regis, Wareham, Dorset.
2nd, No. 2277.—HOOPER BROS., Newburgh, Winfrith, Dorchester.
3rd, No. 2280.—FREDK. W. SURRIDGE, Mucking, Stanford-le-Hope, Essex.
R.N. No. 2279.—FREDK. W. SURRIDGE, Mucking, Stanford-le-Hope, Essex.

Dorset Horns.

No. 2288.—The Dorset Horn Sheep Breeders' Association's Champion Prize of £5 for the best Exhibit to CHARLES JOCELYN HAMBRO.
No. 2281.—R.N. for Champion Prize to W. J. DAWKINS.

Class 279.—*Dorset Horn Ram, Shearling and upwards.*†

1st, No. 2281.—W. J. DAWKINS, Newbold, Gawler River, South Australia, Newbold 77 of 1936.

Class 280.—*Dorset Horn Ram Lamb, born on or after October* 1, 1936.†

1st, No. 2284.—CHARLES JOCELYN HAMBRO, Hedge End Farm, Blandford, Dorset.
2nd, No. 2282.—WILFRED V. CAKE, Lower Burton, Dorchester.
3rd, No. 2283.—CHARLES JOCELYN HAMBRO, Hedge End Farm, Blandford, Dorset.

Class 281.—*Two Dorset Horn Shearling Ewes, born on or after October* 1, 1935.

1st, No. 2288.—CHARLES JOCELYN HAMBRO, Hedge End Farm, Blandford, Dorset.
2nd, No. 2287.—CHARLES JOCELYN HAMBRO, Hedge End Farm.
3rd, No. 2286.—WILFRED V. CAKE, Lower Burton, Dorchester.

Class 282.—*Two Dorset Horn Ewe Lambs, born on or after October* 1, 1936.

1st, No. 2290.—WILFRED V. CAKE, Lower Burton, Dorchester.
2nd, No. 2292.—CHARLES JOCELYN HAMBRO, Hedge End Farm, Blandford, Dorset.
3rd, No. 2291.—CHARLES JOCELYN HAMBRO, Hedge End Farm, Blandford, Dorset.

Wiltshire Horns.

No. 2294.—"Pytchley" Silver Challenge Cup for the best exhibit to G. H. & E. R. MORRIS' Llwynymaen Banker.
No. 2300.—R.N. for "Pytchley" Silver Challenge Cup to P. L. SMITH.

Class 283.—*Wiltshire Horn Ram, Two-Shear and upwards.*‡

1st, No. 2294.—G. H. & E. R. MORRIS, Llwynymaen, Oswestry Llwynymaen Banker 4073.
2nd, No. 2293.—G. H. & E. R. MORRIS, Llwynymaen, Brockhall Ensign 3681.
3rd, No. 2295.—P. L. SMITH, Kislingbury Grange, Northampton.

Class 284.—*Wiltshire Horn Shearling Ram.*

1st, No. 2297.—P. L. SMITH, Kislingbury Grange, Northampton, Charwelton Regent 4574.

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* 1st, 2nd and 3rd Prizes offered by the Dorset Down Sheep Breeders' Association.
† Prizes offered by the Dorset Horn Sheep Breeders' Association.
‡ Prizes offered by the Wiltshire Horn Sheep Society.

Class 285.—*Wiltshire Horn Shearling Ewe.*

1st, No. 2300.—P. L. SMITH, Kislingbury Grange, Northampton.
2nd, No. 2298.—G. H. & E. R. MORRIS, Llwynymaen, Oswestry.
3rd, No. 2301.—P. L. SMITH, Kislingbury Grange, Northampton.
R.N. No. 2299.—G. H. & E. R. MORRIS, Llwynymaen, Oswestry.

Ryelands.

No. 2310.—Ryeland Sheep Silver Challenge Cup for the best Shearling Ram to T. W. MONTAGUE PERKINS' Holme Lacy Obvious.
No. 2311.—R.N. for Challenge Cup to DAVID J. THOMAS'S Thomas's Treasure.

Class 286.—*Ryeland Ram, Two-Shear and upwards.*

1st, No. 2306.—DAVID J. THOMAS, Monachty, Abergavenny, Thomas's Realm 3262.
2nd, No. 2305.—T. W. MONTAGUE PERKINS, Ufton Court, Holme Lacy, Herefordshire, Holme Lacy Narcissus 2nd 3405.
3rd, No. 2304.—CRAWFORD R. L. PERKINS, Lugwardine Court, Herefordshire, Holme Lacy Mac 3406.
R.N. No. 2307.—DAVID J. THOMAS, Monachty, Abergavenny, Thomas's Showman 3393.

Class 287.—*Ryeland Shearling Ram.*

1st, No. 2310.—T. W. MONTAGUE PERKINS, Ufton Court, Holme Lacy, Herefordshire, Holme Lacy Obvious.
2nd, No. 2311.—DAVID J. THOMAS, Monachty, Abergavenny, Thomas's Treasure.
3rd, No. 2313.—DAVID J. THOMAS, Monachty, Thomas's Trophy.
R.N. No. 2308.—T. W. MONTAGUE PERKINS, Ufton Court, Holme Lacy, Herefordshire, Holme Lacy Orator.
H.C. Nos. 2312, 2319.

Class 288.—*Three Ryeland Ram Lambs.*

1st, No. 2319.—CAPT. D. M. WILLS, Barley Wood, Wrington, Somerset.
2nd, No. 2316.—T. W. MONTAGUE PERKINS, Ufton Court, Holme Lacy, Herefordshire.
3rd, No. 2314.—THE EXORS. OF THE LATE LORD CAWLEY, Berrington Hall, Leominster.
R.N. No. 2317.—DAVID J. THOMAS, Monachty, Abergavenny.

Class 289.—*Three Ryeland Shearling Ewes.*

1st, No. 2323.—DAVID J. THOMAS, Monachty, Abergavenny.
2nd, No. 2321.—T. W. MONTAGUE PERKINS, Ufton Court, Holme Lacy, Herefordshire.
3rd, No. 2322.—T. W. MONTAGUE PERKINS, Ufton Court, Holme Lacy.

Kerry Hills (Wales).

No. 2327.—Kerry Hill (Wales) Sheep Silver Challenge Cup for the best exhibit to J. W. OWENS' Stockley Safeguard.
No. 2345.—R.N. for Challenge Cup to THE DUKE OF WESTMINSTER'S Eaton Excellence.

Class 290.—*Kerry Hill (Wales) Ram, Two-Shear and upwards.*

1st, No. 2327.—J. W. OWENS, Woodhouse, Shobdon, Leominster, Stockley Safeguard 19394.
2nd, No. 2326.—J. W. OWENS, Woodhouse, Shelderton Active 19873.
3rd, No. 2328.—THE HON. MRS. SMYTH, Ashton Court, Long Ashton, Bristol, Winsbury Royalist 19516.
R.N. No. 2324.—JOHN T. BEAVAN, Winsbury, Chirbury, Mont., Marlow Elector 18739.

Class 291.—*Kerry Hill (Wales) Shearling Ram.*

1st, No. 2333.—J. W. OWENS, Woodhouse, Shobdon, Leominster, Stockley Tadpole 19906.
2nd, No. 2331.—JOHN T. BEAVAN, Winsbury, Chirbury, Mont., Winsbury Songster 20018.
3rd, No. 2337.—THOMAS WILLIAMS, The Gaer, Forden, Welshpool, Gaer Roger 19657.
R.N. No. 2334.—H. C. PILKINGTON, Bryntanat, Llansantffraid, Mont., Tanatside Partner 19974.

Class 292.—*Kerry Hill (Wales) Ram Lamb.*

1st, No. 2345.—THE DUKE OF WESTMINSTER, G.C.V.O., D.S.O., Eaton Home Farm, Aldford, Chester, Eaton Excellence.
2nd, No. 2338.—JOHN T. BEAVAN, Winsbury, Chirbury, Mont., Winsbury Jilton.
3rd, No. 2339.—BROGYNTYN ESTATE COMPANY, Brogyntyn, Oswestry, Brogyntyn General.
4th, No. 2341.—J. W. OWENS, Woodhouse, Shobdon, Leominster, Stockley Umpire.
R.N. No. 2346.—THOMAS WILLIAMS, The Gaer, Forden, Welshpool, Gaer Sir.

Class 293.—*Three Kerry Hill (Wales) Shearling Ewes.*

1st, No. 2353.—THE DUKE OF WESTMINSTER, G.C.V.O., D.S.O., Eaton Home Farm, Aldford, Chester.
2nd, No. 2350.—H. C. PILKINGTON, Bryntanat, Llansantffraid, Mont.
3rd, No. 2349.—J. W. OWENS, Woodhouse, Shobdon, Leominster.
R.N. No. 2347.—JOHN T. BEAVAN, Winsbury, Chirbury, Mont.

Class 294.—*Three Kerry Hill (Wales) Ewe Lambs.**

1st, No. 2357.—J. W. OWENS, Woodhouse, Shobdon, Leominster.
2nd, No. 2361.—THOMAS WILLIAMS, The Gaer, Forden, Welshpool.
3rd, No. 2354.—JOHN T. BEAVAN, Winsbury, Chirbury, Mont.
R.N. No. 2360.—THE DUKE OF WESTMINSTER, G.C.V.O. D.S.O., Eaton Home Farm, Aldford, Chester.

Clun Forest.

Class 295.—*Clun Forest Ram, Two-Shear and upwards.*

1st, No. 2367.—D. POWELL, Lower Kimbolton, Leominster, Ffostill Gamester No. 1 8236.
2nd, No. 2364.—R. F. MITCHELL EVANS, Cholstrey Court, Leominster, Cholstrey L.12 3209.
3rd, No. 2363.—R. F. MITCHELL EVANS, Cholstrey Court, Glen Briton 2404.
H.C. No. 2362.

Class 296.—*Clun Forest Shearling Ram.*

1st, No. 2370.—R. F. MITCHELL EVANS, Cholstrey Court, Leominster, Cholstrey M.7.
2nd, No. 2371.—T. E. GWILLIM, Ffostill, Talgarth, Brecon, Ffostill Herald 4th.
3rd, No. 2369.—DAVIES BROS., Fields End, Weobley, Hereford, Fields End Gem.
H.C. No. 2374.

Class 297.—*Clun Forest Ram Lamb.*

1st, No. 2377.—DAVIES BROS., Fields End, Weobley, Hereford, Fields End Harold.
2nd, No. 2380.—MISS EILEEN A. L. ROSSITER, Glen Alva, Eways Harold, Pontrilas, Hereford, Glen George VI.
3rd, No. 2379.—T. E. GWILLIM, Ffostill, Talgarth, Brecon, Ffostill Imp.
H.C. No. 2378.

Class 298.—*Clun Forest Shearling Ewe.*

1st, No. 2382.—DAVIES BROS., Fields End, Weobley, Hereford.
2nd, No. 2388.—E. J. SHERWOOD, Beaconsfield, Battlefield, Shrewsbury.
3rd, No. 2385.—T. E. GWILLIM, Ffostill, Talgarth, Brecon.
H.C. No. 2384.

Class 299.—*Clun Forest Ewe Lamb.*†

1st, No. 2392.—T. E. GWILLIM, Ffostill, Talgarth, Brecon.
2nd, No. 2389.—DAVIES BROS., Fields End, Weobley, Hereford.
3rd, No. 2394.—E. J. SHERWOOD, Beaconsfield, Battlefield, Shrewsbury.
H.C. No. 2390.

Lincolns.

No. 2398.—Lincoln Longwool Sheep Breeders' Association's Special Prize of £5 for the best Shearling Ram to CLIFFORD NICHOLSON.
No. 2399.—R.N. for Special Prize to CLIFFORD NICHOLSON.

Class 300.—*Lincoln Shearling Ram.*

1st, No. 2398.—CLIFFORD NICHOLSON, Willoughton Manor, Lincoln.
2nd, No. 2399.—CLIFFORD NICHOLSON, Willoughton Manor, Lincoln.
3rd, No. 2396.—ERNEST ADDISON, Riby Grange, Grimsby.

Class 301.—*Three Lincoln Shearling Rams.*

1st, No. 2406.—CLIFFORD NICHOLSON, Willoughton Manor, Lincoln.
2nd, No. 2402.—ERNEST ADDISON, Riby Grange, Grimsby.
3rd, No. 2404.—D. F. BROWETT, Thornton House, Thornton, Horncastle.

Class 302.—*Three Lincoln Ram Lambs.*

1st, No. 2409.—CLIFFORD NICHOLSON, Willoughton Manor, Lincoln.
2nd, No. 2407.—ERNEST ADDISON, Riby Grange, Grimsby.
3rd, No. 2410.—THE SCOTHERN DAIRY CO., Scothern Manor, Lincoln.
R.N. No. 2408.—D. F. BROWETT, Thornton House, Thornton, Horncastle.

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* Prizes offered by the Kerry Hill (Wales) Flock Book Society.
† Prizes offered by the Clun Forest Sheep Breeders' Association.

Class 303.—*Three Lincoln Ewe Lambs.*

1st, No. 2413.—CLIFFORD NICHOLSON, Willoughton Manor, Lincoln.
2nd, No. 2411.—ERNEST ADDISON, Riby Grange, Grimsby.
3rd, No. 2412.—D. F. BROWETT, Thornton House, Thornton, Horncastle.

Leicesters.

No. 2414.—Leicester Sheep Breeders' Association's Champion Prize for the best exhibit to WILLIAM JORDAN.
No. 2415.—R.N. for Champion Prize to WILLIAM JORDAN.

Class 304.—*Leicester Shearling Ram.*

1st, No. 2414.—WILLIAM JORDAN, Eastburn, Driffield.
2nd, No. 2415.—WILLIAM JORDAN, Eastburn, Driffield.
3rd, No. 2417.—THE EXORS. OF R. H. STOCKS, Haywold, North Dalton, Driffield.
R.N. No. 2416.—THE EXORS. OF R. H. STOCKS, Haywold, North Dalton, Driffield.

Class 305.—*Leicester Ram Lamb.*

1st, No. 2423.—THE EXORS. OF R. H. STOCKS, Haywold, North Dalton, Driffield.
2nd, No. 2422.—THE EXORS. OF R. H. STOCKS, Haywold, North Dalton, Driffield.
3rd, No. 2418.—JOHN T. ALLISON, Low House, Stanghow, Saltburn.
R.N. No. 2421.—WILLIAM JORDAN, Eastburn, Driffield.
H.C. No. 2420. C. No. 2419.

Class 306.—*Leicester Shearling Ewe.*

1st, No. 2426.—WILLIAM JORDAN, Eastburn, Driffield.
2nd, No. 2425.—WILLIAM JORDAN, Eastburn, Driffield.
3rd, No. 2424.—WILLIAM JORDAN, Eastburn, Driffield.

Class 307.—*Leicester Ewe Lamb.*

1st, No. 2429.—THE EXORS. OF R. H. STOCKS, Haywold, North Dalton, Driffield.
2nd, No. 2428.—WILLIAM JORDAN, Eastburn, Driffield.
3rd, No. 2430.—THE EXORS. OF R. H. STOCKS, Haywold, North Dalton, Driffield.
R.N. No. 2472.—JOHN T. ALLISON, Low House, Stanghow, Saltburn.

Border Leicesters.

No. 2450.—Society of Border Leicester Sheep Breeders' Perpetual Silver Challenge Cup for the best Ram or Ewe to DONALD CROSS.
No. 2433.—R.N. for Challenge Cup to DONALD CROSS' Salaam.

Class 308.—*Border Leicester Ram, Two-Shear and upwards.*

1st, No. 2433.—DONALD CROSS, Knockdon, Maybole, Salaam 10484.

Class 309.—*Border Leicester Shearling Ram.*

1st, No. 2437.—COL. E. W. S. BALFOUR, D.S.O., O.B.E., M.C., Balbirnie, Markinch, Fife.
2nd, No. 2435.—COL. E. W. S. BALFOUR, D.S.O., O.B.E., M.C., Balbirnie.
3rd, No. 2439.—R. C. CAMERON, Greenlawdean, Greenlaw, Berwickshire, Greenlaw Juba 11155.
4th, No. 2442.—DONALD CROSS, Knockdon, Maybole.
5th, No. 2434.—COL. E. W. S. BALFOUR, D.S.O., O.B.E., M.C., Balbirnie, Markinch, Fife.
R.N. No. 2441.—R. C. CAMERON, Greenlawdean, Greenlaw, Berwickshire.

Class 310.—*Border Leicester Ewe, Two-Shear and upwards.**

1st, No. 2450.—DONALD CROSS, Knockdon, Maybole.
2nd, No. 2449.—COL. E. W. S. BALFOUR, D.S.O., O.B.E., M.C., Balbirnie, Markinch, Fife.
3rd, No. 2451.—A. B. HOWIE, Eshott Brocks, Felton, Morpeth.

Class 311.—*Border Leicester Shearling Ewe.*

1st, No. 2457.—DONALD CROSS, Knockdon, Maybole.
2nd, No. 2453.—COL. E. W. S. BALFOUR, D.S.O., O.B.E., M.C., Balbirnie, Markinch, Fife.
3rd, No. 2452.—COL. E. W. S. BALFOUR, D.S.O., O.B.E., M.C., Balbirnie.
R.N. No. 2455.—R. C. CAMERON, Greenlawdean, Greenlaw, Berwickshire.

Wensleydales.

No. 2462.—Wensleydale Longwool Sheep Breeders' Association's Silver Challenge Trophy for the best exhibit to JOHN DARGUE.
No. 2459.—R.N. for Challenge Trophy to JOHN DARGUE'S Burneside Supreme.

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* Prizes offered by the Society of Border Leicester Sheep Breeders.

Class 312.—*Wensleydale Ram, Two-Shear and upwards.*

1st, No. 2459.—John Dargue, Burneside Hall, Kendal, Burneside Supreme 4121.
2nd, No. 2460.—John Dargue, Burneside Hall, Easthouse Blue Prince 4135.
3rd, No. 2461.—T. B. Earle, Bolton Grange, Scorton, Richmond, Yorks., Caperby Blue Brocade 4083.

Class 313.—*Wensleydale Shearling Ram.*

1st, No. 2462.—John Dargue, Burneside Hall, Kendal.
2nd, No. 2463.—John Dargue, Burneside Hall.
3rd, No. 2465.—John Percival, Easthouse, Carperby, Yorks.
R.N. No. 2464.—T. B. Earle, Bolton Grange, Scorton, Richmond, Yorks.

Class 314.—*Three Wensleydale Shearling Rams.*

1st, No. 2468.—John Dargue, Burneside Hall, Kendal.
2nd, No. 2470.—John Percival, Easthouse, Carperby Yorks.
3rd, No. 2469.—John Percival, Easthouse.

Class 315.—*Wensleydale Shearling Ewe.*

1st, No. 2472.—John Dargue, Burneside Hall, Kendal.
2nd, No. 2471.—John Dargue, Burneside Hall.
3rd, No. 2475.—John Percival, Easthouse, Carperby, Yorks.
R.N. No. 2474.—T. B. Earle, Bolton Grange, Scorton, Richmond, Yorks.

Class 316.—*Wensleydale Yearling Ewe, shown in Wool.**

1st, No. 2481.—John Percival, Easthouse, Carperby, Yorks.
2nd, No. 2478.—John Dargue, Burneside Hall, Kendal.
3rd, No. 2477.—John Dargue, Burneside Hall.
R.N. No. 2479.—T. B. Earle, Bolton Grange, Scorton, Richmond, Yorks.

Kent or Romney Marsh.

No. 2494.—Kent or Romney Marsh Sheep Breeders' Association's Champion Prize of 10 guineas for the best Ram to J. Egerton Quested.
No. 2485.—R.N. for Champion Prize to J. Egerton Quested's Quested's 224 of 1935 79879.
No. 2518.—Kent or Romney Marsh Sheep Breeders' Association's Champion Prize of 10 guineas for the best Pen of Ewes or Ewe Lambs to J. Egerton Quested.
No. 2519.—R.N. for Champion Prize to Ashley Stevens.

Class 317.—*Kent or Romney Marsh Two-Shear Ram.*

1st, No. 2485.—J. Egerton Quested, The Firs, Cheriton, Kent, Quested's 224 of 1935 79879.
2nd, No. 2484.—J. Egerton Quested, The Firs, Quested's 29 of 1935 79784.
3rd, No. 2483.—Clifford Nicholson, Willoughton Manor, Lincoln, Horkstow Manor No. 135 of 1935 80517.

Class 318.—*Kent or Romney Marsh Shearling Ram.*

1st, No. 2494.—J. Egerton Quested, The Firs, Cheriton, Kent.
2nd, No. 2495.—J. Egerton Quested, The Firs.
3rd, No. 2493.—Clifford Nicholson, Willoughton Manor, Lincoln.
4th, No. 2497.—Ashley Stevens, Davington Hall, Faversham.
5th, No. 2498.—Ashley Stevens, Davington Hall.
R.N. No. 2496.—J. Egerton Quested, The Firs, Cheriton, Kent.
H.C. No. 2486.

Class 319.—*Three Kent or Romney Marsh Shearling Rams.*†

1st, £20. No. 2504.—J. Egerton Quested, The Firs, Cheriton, Kent.
2nd, £15. No. 2503.—J. Egerton Quested, The Firs.
3rd, £10. No. 2501.—Clifford Nicholson, Willoughton Manor, Lincoln.
4th, £5. No. 2499.—E. W. Baker, Parsonage Farm, Bekesbourne, Canterbury.

Class 320.—*Three Kent or Romney Marsh Ram Lambs.*

1st, No. 2507.—Clifford Nicholson, Willoughton Manor, Lincoln.
2nd, No. 2508.—Clifford Nicholson, Willoughton Manor.
3rd, No. 2510.—J. Egerton Quested, The Firs, Cheriton, Kent.
R.N. No. 2509.—J. Egerton Quested, The Firs.

* Prizes offered by the Wensleydale Longwool Sheep Breeders' Association.
† Prizes offered by the Kent or Romney Marsh Sheep Breeders' Association.

Class 321.—*Three Kent or Romney Marsh Shearling Ewes.*

1st, No. 2518.—J. EGERTON QUESTED, The Firs, Cheriton, Kent.
2nd, No. 2519.—ASHLEY STEVENS, Davington Hall, Faversham.
3rd, No. 2513.—PERCY HICKMAN, Pett Farm, Charing, Kent.

R.N. No. 2512.—E. W. BAKER, Parsonage Farm, Bekesbourne, Canterbury.
H.C. No. 2517.

Class 322.—*Three Kent or Romney Marsh Ewe Lambs.*

1st, No. 2524.—J. EGERTON QUESTED, The Firs, Cheriton, Kent.
2nd, No. 2521.—CLIFFORD NICHOLSON, Willoughton Manor, Lincoln.
3rd, No. 2522.—CLIFFORD NICHOLSON, Willoughton Manor.

R.N. No. 2520.—PERCY HICKMAN, Pett Farm, Charing, Kent.
H.C. No. 2523.

Devon Long-Wools.

Class 323.—*Devon Long-Wool Shearling Ram.*

1st, No. 2526.—ROBERT LAWRENCE, Rull, Cullompton.
2nd, No. 2528.—M. H. WATTS & SON, Knowle, Okehampton, Devon.
3rd, No. 2527.—WILLIAM M. SNELL, Orway, Kentisbeare, Cullompton, **Orway Curly Coat.**

Class 324.—*Devon Long-Wool Shearling Ewe.*

1st, No. 2531.—M. H. WATTS & SON, Knowle, Okehampton, Devon.
2nd, No. 2529.—ROBERT LAWRENCE, Rull, Cullompton.
3rd, No. 2530.—WILLIAM M. SNELL, Orway, Kentisbeare, Cullompton.

Devon Close-Wools.

Classes 325 and 326.

[NO ENTRY.]

South Devons.

Class 327.—*South Devon Shearling Ram.*

1st, No. 2534.—A. C. LANYON, Coswarth, St. Columb, Cornwall.
2nd, No. 2533.—J. N. GROSE, Penare, Gorran, Cornwall, **Penare No. 1 of 1936 25547.**
3rd, No. 2532.—W. F. R. RICE, Nanswhyden, St. Columb, Cornwall, **Nanswhyden No. 19 of 1936 25487.**

Class 328.—*South Devon Shearling Ewe, shown in Wool.*

1st, No. 2535.—W. F. R. RICE, Nanswhyden, St. Columb, Cornwall.
2nd, No. 2536.—J. N. GROSE, Penare, Gorran, Cornwall.
3rd, No. 2537.—A. C. LANYON, Coswarth, St. Columb, Cornwall.

Dartmoors.

(*Shown in Wool.*)

Class 329.—*Dartmoor Ram, Shearling and upwards.*

1st, No. 2538.—J. H. COLE, Chaddlehanger, Tavistock, **Chaddlehanger Marvel 5118.**
2nd, No. 2540.—RICHARD PALMER LUCE, Lower Chaddlehanger, Tavistock, **Lamerton Abundant 5166.**
3rd, No. 2539.—GEORGE GLANFIELD, West Lake, Okehampton, **Fatherford No. 35 5300.**

Class 330.—*Dartmoor Shearling Ewe.*

1st, No. 2541.—J. H. COLE, Chaddlehanger, Tavistock.
2nd, No. 2543.—RICHARD PALMER LUCE, Lower Chaddlehanger, Tavistock.
3rd, No. 2542.—J. H. COLE, Chaddlehanger, Tavistock.

Cheviots.

Classes 331 and 332.—

[NO ENTRY.]

Welsh Mountain.

Class 333.—*Welsh Mountain Ram, Shearling and upwards.*

1st, No. 2549.—UNIVERSITY COLLEGE OF NORTH WALES, College Farm, Aber, Snowdon G.5.
2nd, No. 2548.—G. J. THOMAS, Carregcegin, Llandilo, Carm.
3rd, No. 2546.—MAJOR ERIC J. W. PLATT, Madryn Farm, Aber, Glan H.8 5625.
R.N. No. 2545.—MAJOR ERIC J. W. PLATT, Madryn Farm, Madryn J.34 5591.
H.C. No. 2544. C. No. 2547.

Class 334.—*Three Welsh Mountain Shearling Ewes.*

1st, No. 2550.—LLYSFASI FARM INSTITUTE, Ruthin.
2nd, No. 2556.—UNIVERSITY COLLEGE OF NORTH WALES, College Farm, Aber.
3rd, No. 2552.—J. OWEN MORRIS, Brynowen, Borth, Cards.
R.N. No. 2551.—LLYSFASI FARM INSTITUTE, Ruthin.
H.C. No. 2555. C. No. 2554.

Black Welsh Mountain.

(Shown out of Wool.)

Class 335.—*Black Welsh Mountain Shearling Ram.*

1st, No. 2559.—THE HON. MRS. C. BEHRENS, Swinton Grange, Malton, Yorks.
2nd, No. 2560.—THE HON. MRS. C. BEHRENS, Swinton Grange, Swinton Black Knight 3rd.
3rd, No. 2562.—MRS. JERVOISE, Herriard Park, Basingstoke.
H.C. No. 2561.

Class 336.—*Three Black Welsh Mountain Shearling Ewes.**

1st, No. 2565.—THE HON. MRS. C. BEHRENS, Swinton Grange, Malton, Yorks.
2nd, No. 2564.—THE HON. MRS. C. BEHRENS, Swinton Grange.
3rd, No. 2568.—CAPT. G. C. WOLRYCHE-WHITMORE, Dudmaston, Bridgnorth.
R.N. No. 2567.—MRS. JERVOISE, Herriard Park, Basingstoke.
H.C. No. 2563. C. No. 2566.

PIGS.

The Prizes for Pigs are: First, £10; Second, £5; Third, £3; Fourth, £2; Fifth, £1.

(The numbers in brackets refer to the Tattoo or Ear Numbers of the Animals.)

Large Whites.

No. 2571.—N.P.B.A. Champion Gold Medal for the best Boar and R.N. for Silver Challenge Cup for the best Pig to CHIVERS & SONS' Tring Basil 3rd.
No. 2606.—R.N. for Champion Gold Medal to ALFRED W. WHITE'S Spalding Prince George 18th.
No. 2700.—N.P.B.A. Champion Gold Medal for the best Sow and Challenge Cup for the best Pig to WALTER W. RYMAN'S Wall Jubilee Maple.
No. 2729.—R.N. for Champion Gold Medal to ALFRED W. WHITE'S Spalding Reine 52nd.

N.P.B.A. Special Prizes for best Groups of Large White Pigs bred by Exhibitor:—
1st, £10, Nos. 2578, 2624, 2700, 2720, to WALTER W. RYMAN'S Wall King David 59th, Wall Majestic 40th, Wall Jubilee Maple and Wall Brocade 7th.
2nd, £5, Nos. 2591, 2694, 2716, 2738, to LORD DARESBURY'S Walton Jay 165th, Walton Blackberry 4th, Walton Maid 5th and Walton Queen Mary 98th.
3rd, £3, Nos. 2606, 2679, 2707, 2729, to ALFRED W. WHITE'S Spalding Prince George 18th, Spalding Prince George 21st, Spalding Queen 15th and Spalding Reine 52nd.
R.N., Nos. 2588, 2688, 2718, 2734, to CHIVERS & SONS' Histon Basil 16th, Histon Dainty Girl 369th, Histon Dainty Girl 409th and Histon Belle 306th.

Class 337.—*Large White Boar, born in or before 1935.*

1st, No. 2571.—CHIVERS & SONS, LTD., Histon, Cambridge, Tring Basil 3rd 91029 (9).
2nd, No. 2578.—WALTER W. RYMAN, The Manor and Pipe Place Farms, Wall, Lichfield, Wall King David 59th 91213 (5860).
3rd, No. 2577.—J. PIERPONT MORGAN, Wall Hall, Aldenham, Watford, Aldenham Bradbury 54th 87141 (500).

* Prizes offered by the Black Welsh Mountain Sheep Breeders' Association.

4th, No. 2573.—A. H. COOPER, Drointon, Stowe-by-Chartley, Stafford, Wall King David 85th 101639 (7230).
5th, No. 2574.—LORD DARESBURY, C.V.O., Walton Hall, Warrington, Glebe John 99285 (506).
R.N. No. 2580.—R. SILCOCK & SONS, LTD., Thornton Hall Farm, Thornton-le-Fylde, Westacre Bandmaster 10th 96807 (6585).
H.C. Nos. 2569, 2582. C. Nos. 2581, 2584.

Class 338.—*Large White Boar, born in* 1936, *before July* 1.

1st, No. 2606.—ALFRED W. WHITE, Hillegom, Spalding, Spalding Prince George 18th (6059).
2nd, No. 2591.—LORD DARESBURY, C.V.O., Walton Hall, Warrington, Walton Jay 165th 101837 (5828).
3rd, No. 2588.—CHIVERS & SONS, LTD., Histon, Cambridge, Histon Basil 16th 99689 (1510).
4th, No. 2589.—CHIVERS & SONS, LTD., Histon, Histon East Lad 27th (1650).
5th, No. 2598.—LESLIE K. OSMOND, Barnoldby-le-Beck, Grimsby, Beelsby Boy 8th (822).
R.N. No. 2594.—ERNEST HARDING, Packwood Grange, Dorridge, Birmingham, Packwood Bar None 60th (5613).
H.C. Nos. 2595, 2599. C. Nos. 2585, 2592, 2597, 2601, 2604.

Class 339.—*Large White Boar, born in* 1936, *on or after July* 1.*

1st, No. 2618.—HERBERT JACKSON, Chowley Oak Farm, Handley, Chester, Westacre Basil 43rd (7278).
2nd, No. 2624.—WALTER W. RYMAN, The Manor and Pipe Place Farms, Wall, Lichfield, Wall Majestic 40th (7649)
3rd, No. 2615.—LORD DARESBURY, C.V.O., Walton Hall, Warrington, Whittingham Hercules 15th (4659).
4th, No. 2620.—ALFRED LEWIS, Panworth Hall, Ashill, Thetford, Westacre Basil 56th (7347).
5th, No. 2619.—T. P. P. KENT, Ashford House, Ashford, Barnstaple, Taw Korimako 5th 101165 (250).
R.N. No. 2625.—FRANK SAINSBURY, Blunts Hall, Little Wratting, Haverhill, Wratting King David 34th 102243 (W. 358).
H.C. Nos. 2611, 2613, 2616. C. No. 2631.

Class 340.—*Large White Boar, born in* 1937.

1st, No. 2654.—D. R. DAYBELL & SON, Bottesford, Nottingham, Bottesford Bradbury 55th (832).
2nd, No. 2652.—LORD DARESBURY, C.V.O., Walton Hall, Warrington, Walton King David 39th (6349).
3rd, No. 2640.—H. W. BISHOP, Park Hill Farm, Tring, Tring King David 6th (1062).
4th, No. 2679.—ALFRED W. WHITE, Hillegom, Spalding, Spalding Prince George 21st (7027).
5th, No. 2665.—WALTER W. RYMAN, The Manor and Pipe Place Farms, Wall, Lichfield, Wall King David 91st (7883).
R.N. No. 2641.—MISS M. H. BOUVERIE, O.B.E., Delapre Abbey, Northampton, Delapre Yeoman 6th (830).
H.C. Nos. 2637, 2655, 2662, 2663, 2680. C. Nos. 2656, 2666, 2669.

Class 341.—*Large White Breeding Sow, born in or before* 1935.

1st, No. 2700.—WALTER W. RYMAN, The Manor and Pipe Place Farms, Wall, Lichfield, Wall Jubilee Maple 254160 (6938).
2nd, No. 2688.—CHIVERS & SONS, LTD., Histon, Cambridge, Histon Dainty Girl 369th 260486 (S. 405).
3rd, No. 2692.—LORD DARESBURY, C.V.O., Walton Hall, Warrington, Tockwith Catalina 42nd 251362 (4244).
4th, No. 2689.—CHIVERS & SONS, LTD., Histon, Cambridge, Creek Daisy Girl 10th 244680 (162).
5th, No. 2707.—ALFRED W. WHITE, Hillegom, Spalding, Spalding Queen 15th 263820 (5020).
R.N. No. 2694.—LORD DARESBURY, C.V.O., Walton Hall, Walton Blackberry 4th 252178 (4701).
H.C. Nos. 2683, 2702. C. Nos. 2686, 2705.

Class 342.—*Large White Sow, born in* 1936, *before July* 1.

1st, No. 2729.—ALFRED W. WHITE, Hillegom, Spalding, Spalding Reine 52nd 263826 (6008).
2nd, No. 2716.—LORD DARESBURY, C.V.O., Walton Hall, Warrington, Walton Maid 5th (5838).
3rd, No. 2720.—WALTER W. RYMAN, The Manor and Pipe Place Farms, Wall, Lichfield, Wall Brocade 7th 265188 (7454).
4th, No. 2713.—CHIVERS & SONS, LTD., Histon, Cambridge, Histon Dainty Girl 409th (S. 638).
5th, No. 2714.—CHIVERS & SONS, LTD., Histon, Histon Dainty Girl 410th (S. 639).
R.N. No. 2728.—ALFRED W. WHITE, Hillegom, Spalding, Spalding May Queen 8th (6054).
H.C. Nos. 2711, 2719. C. Nos. 2715, 2730.

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* 1st, 2nd and 3rd Prizes offered by National Pig Breeders' Association.

Class 343.—*Large White Sow, born in* 1936, *on or after July* 1.

1st, No. 2738.—LORD DARESBURY, C.V.O., Walton Hall, Warrington, **Walton Queen Mary 98th** (6089).
2nd, No. 2739.—LORD DARESBURY, C.V.O., Walton Hall, **Walton Wallflower 20th** (6134).
3rd. No. 2734.—CHIVERS & SONS, LTD., Histon, Cambridge, **Histon Belle 306th** (35).
4th, No. 2745.—WALTER W. RYMAN, The Manor and Pipe Place Farms, Wall, Lichfield, **Wall Maple Leaf 10th** (7750).
5th, No. 2740.—ERNEST HARDING, Packwood Grange, Dorridge, Birmingham, **Packwood Bonetta 24th** (5757).

R.N. No. 2744.—J. W. ROBERTS, Hill Farm, Shefford, Beds., **Shefford Beryl 12th** (550).
H.C. No. 2742. C. Nos. 2735, 2746.

Class 344.—*Large White Sow, born in* 1937.

1st, No. 2771.—ALFRED LEWIS, Panworth Hall, Ashill, Thetford, **Westacre Dainty Girl 71st** (7400).
2nd, No. 2775.—WALTER W. RYMAN, The Manor and Pipe Place Farms, Wall, Lichfield, **Wall Mana 18th** (7903).
3rd, No. 2769.—ERNEST HARDING, Packwood Grange, Dorridge, Birmingham, **Packwood Dainty Girl 13th** (7016).
4th, No. 2764.—LORD DARESBURY, C.V.O., Walton Hall, Warrington, **Walton Belle 81st** (6415).
5th, No. 2752.—H. W. BISHOP, Park Hill Farm, Tring, **Tring Dainty Girl 63rd** (1064).
R.N. No. 2770.—HERBERT JACKSON, Chowley Oak Farm, Handley, Chester, **Handley Bashful Lady 144th** (3091).
H.C. Nos. 2766, 2772. C. Nos. 2765, 2768.

Middle Whites.

No. 2787.—N.P.B.A. Champion Gold Medal for the best Boar and R.N. for Silver Challenge Cup for the best Pig to CAPT. D. P. LITHGOW'S **Newton Trident.**
No. 2796.—R.N. for Champion Gold Medal to THE CITY OF LONDON MENTAL HOSPITAL'S **Dartford Gog 2nd.**
No. 2819.—N.P.B.A. Champion Gold Medal for the best Sow and Silver Challenge Cup for the best Pig to FRANK SAINSBURY'S **Wratting Garland 3rd.**
No. 2831.—R.N. for Champion Gold Medal to THE WATFORD CORPORATION'S **Watford Gracious Lady 15th.**

N.P.B.A. Special Prizes for best Groups of Middle White Pigs bred by Exhibitor:—

1st, Gold Medal, Nos. 2801, 2830, 2838, 2846, to R. A. VESTEY'S **Dunsdale Cocktail, Dunsdale Lady Dorothy 9th, Dunsdale Princess Royal and Dunsdale Misty 13th.**
2nd, Silver Gilt Medal, Nos. 2809, 2816, 2823, 2831, to WATFORD CORPORATION'S **Watford Hold Hard, Watford Prince Regent, Watford Gracious Lady and Watford Gracious Lady 15th.**

R.N., Nos. 2796, 2813, 2833, 2843, to CITY OF LONDON MENTAL HOSPITAL'S **Dartford Gog 2nd, Dartford Prince, Dartford Matilda and Dartford Welcome 4th.**

Class 345.—*Middle White Boar, born in or before* 1935.

1st, No. 2787.—CAPT. D. P. LITHGOW, South Newington Manor, Banbury, **Newton Trident 97583** (1926).
2nd, No. 2792.—WATFORD CORPORATION, Holywell Farm, Watford, **Northcote Preceptor 97595** (750).
3rd, No. 2789.—CITY OF LONDON MENTAL HOSPITAL, Dartford, Kent, **Norsbury Gog 82553** (4105).

R.N. No. 2791.—JOSEPH TRIFFITT, Fulford, York, **Colton Clink 92089** (300).

Class 346.—*Middle White Boar, born in* 1936, *before July* 1.

1st, No. 2796.—CITY OF LONDON MENTAL HOSPITAL, Dartford, Kent, **Dartford Gog 2nd 97509** (2164).
2nd, No. 2801.—R. A. VESTEY, Valence, Westerham, Kent, **Dunsdale Cocktail** (828).
3rd, No. 2793.—THE HON. A. E. GUINNESS, Holmbury House, Holmbury St. Mary, Dorking, **Holmbury Prince 4th** (168).
4th, No. 2798.—FRANK SAINSBURY, Blunts Hall, Little Wratting, Haverhill, **Wratting Bold Boy 97645** (W. 248).

R.N. No. 2800.—JOSEPH TRIFFITT, Fulford, York, **Colton Clink 2nd** (412).

Class 347.—*Middle White Boar, born in* 1936, *on or after July* 1.*

1st, No. 2809.—WATFORD CORPORATION, Holywell Farm, Watford, **Watford Hold Hard** (410).
2nd, No. 2807.—JOSEPH TRIFFITT, Fulford, York, **Colton Clink 3rd** (424).
3rd, No. 2804.—CAPT. D. P. LITHGOW, South Newington Manor, Banbury, **Newton Nubian** (2913).

* Prizes offered by the National Pig Breeders' Association.

Class 348.—*Middle White Boar, born in* 1937.

1st, No. 2816.—WATFORD CORPORATION, Holywell Farm, Watford, **Watford Prince Regent (498).**
2nd, No. 2813.—CITY OF LONDON MENTAL HOSPITAL, Dartford, Kent, **Dartford Prince (2301).**
3rd, No. 2811.—W. W. BUCKLE, Old Lane Farm, Colton, Tadcaster, **Colton Clink 4th (483).**
R.N. No. 2815.—R. A. VESTEY, Valence, Westerham, Kent, **Dunsdale White Prince (1049).**
H.C. No. 2814.

Class 349.—*Middle White Breeding Sow, born in or before* 1935.

1st, No. 2819.—FRANK SAINSBURY, Blunts Hall, Little Wratting, Haverhill, **Wratting Garland 3rd 241930 (996).**
2nd, No. 2823.—WATFORD CORPORATION, Holywell Farm, Watford, **Watford Gracious Lady 228370 (762).**
3rd, No. 2820.—JOSEPH TRIFFITT, Fulford, York, **Watford Gracious Lady 14th 254762 (242).**
R.N. No. 2817.—THE HON. A. E. GUINNESS, Holmbury House, Holmbury St. Mary, Dorking, **Pendley Helah 33rd 218592 (618).**

Class 350.—*Middle White Sow, born in* 1936, *before July* 1.

1st, No. 2831.—WATFORD CORPORATION, Holywell Farm, Watford, **Watford Gracious Lady 15th 254768 (287).**
2nd, No. 2830.—R. A. VESTEY, Valence, Westerham, Kent, **Dunsdale Lady Dorothy 9th (778).**
3rd, No. 2829.—JOSEPH TRIFFITT, Fulford, York, **Watford Helah 7th 254804 (272).**
R.N. No. 2824.—THE HON. A. E. GUINNESS, Holmbury House, Holmbury St. Mary, Dorking, **Holmbury Helah (170).**
H.C. No. 2828. C. No. 2826.

Class 351.—*Middle White Sow, born in* 1936, *on or after July* 1.

1st, No. 2838.—R. A. VESTEY, Valence, Westerham, Kent, **Dunsdale Princess Royal (910).**
2nd, No. 2833.—CITY OF LONDON MENTAL HOSPITAL, Dartford, Kent, **Dartford Matilda (2283).**
3rd, No. 2837.—R. A. VESTEY, Valence, Westerham, Kent, **Dunsdale Princess (909).**
R.N. No. 2836.—FRANK SAINSBURY, Blunts Hall, Little Wratting, Haverhill, **Wratting Miss Dorothy 5th (W. 270).**
H.C. No. 2839. C. No. 2834.

Class 352.—*Middle White Sow, born in* 1937.

1st, No. 2842.—JOSEPH S. HICKS, Fordon, Wold Newton, Driffield, **Fordon Delightful 4th (660).**
2nd, No. 2846.—R. A. VESTEY, Valence, Westerham, Kent, **Dunsdale Misty 13th (1058).**
3rd, No. 2844.—LESLIE K. OSMOND, Barnoldby-le-Beck, Grimsby, **Beelsby Garland 8th (1543).**
R.N. No. 2840.—S. T. BRUNT, The Manor House, Bexley, Kent, **Crayvalley Choice 2nd (1047).**
H.C. No. 2843. C. No. 2847.

Tamworths.

No. 2850.—N.P.B.A. Silver Gilt Medal for the best Boar and Challenge Cup for the best Pig to MRS. M. C. INGE'S **Wall Red Star.**
No. 2860.—R.N. for Silver Gilt Medal to T. R. WILSON'S **Rufforth Red Knight.**
No. 2879.—N.P.B.A. Silver Gilt Medal for the best Sow and R.N. for Challenge Cup for the best Pig to MRS. M. C. INGE'S **Inge Velvet 7th.**
No. 2871.—R.N. for Silver Gilt Medal to COL. C. J. H. WHEATLEY'S **Berkswell Rose 14th.**

Class 353.—*Tamworth Boar, born in or before* 1935.

1st, No. 2850.—MRS. M. C. INGE, Thorpe Hall, Tamworth, **Wall Red Star 97709 (252).**
2nd, No. 2849.—MRS. M. C. INGE, Thorpe Hall, **Wall Ducat 92041 (199).**
3rd, No. 2848.—MRS. CARLETON COWPER, Eamont, Penrith, **Eamont Hero 97265 (27).**
R.N. No. 2851.—COL. C. J. H. WHEATLEY, Berkswell Hall, Coventry, **Berkswell Up-to-Date 11th 92001 (887).**

Class 354.—*Tamworth Boar, born in* 1936.*

1st, No. 2860.—T. R. WILSON, Victoria House, Rufforth, Yorks., **Rufforth Red Knight (383).**
2nd, No. 2858.—COL. C. J. H. WHEATLEY, Berkswell Hall, Coventry, **Berkswell Up-to-Date 22nd 97667 (1052).**
3rd, No. 2855.—MRS. CARLETON COWPER, Eamont, Penrith, **Kentmere John Peel (8).**
R.N. No. 2853.—H. CLIFTON-BROWN, Burnham Grove, Burnham, Bucks., **Burnham Red Peter 97675 (458).**
H.C. Nos. 2856, 2857. C. No. 2854.

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*Prizes offered by the National Pig Breeders' Association.

Class 355.—*Tamworth Boar, born in* 1937.

1st, No. 2862.—MRS. CARLETON COWPER, Eamont, Penrith, **Eamont Notorious** (74).
2nd, No. 2865.—COL. C. J. H. WHEATLEY, Berkswell Hall, Coventry, **Berkswell Up-to-Date 25th** (1112).
3rd, No. 2861.—E. CLIFTON-BROWN, Burnham Grove, Burnham, Bucks., **Burnham Pat** (502).
R.N. No. 2866.—COL. C. J. H. WHEATLEY, Berkswell Hall, Coventry, **Berkswell Up-to-Date 26th** (1116).
H.C. No. 2867. C. No. 2863.

Class 356.—*Tamworth Breeding Sow, born in or before* 1935.

1st, No. 2871.—COL. C. J. H. WHEATLEY, Berkswell Hall, Coventry, **Berkswell Rose 14th** 253880 (918).
2nd, No. 2869.—CHARLES L. COXON, Milton, Pembridge, Leominster, **Milton Gloriana 9th** 253958 (481).
3rd, No. 2872.—T. R. WILSON, Victoria House, Rufforth, Yorks., **Rufforth Lass 2nd** 241098 (186).
R.N. No. 2868.—MRS. CARLETON COWPER, Eamont, Penrith, **Eamont Heroine** 253908 (29).
H.C. No. 2870.

Class 357.—*Tamworth Sow, born in* 1936.

1st, No. 2879.—MRS. M. C. INGE, Thorpe Hall, Tamworth, **Inge Velvet 7th** 254968 (142).
2nd, No. 2880.—COL. C. J. H. WHEATLEY, Berkswell Hall, Coventry, **Berkswell Rose 23rd** 254882 (1057)
3rd, No. 2875.—MRS. CARLETON COWPER, Eamont, Penrith, **Eamont Lemonade** 254932 (68).
4th, No. 2876.—ROWLAND P. HAYNES, Delves Green Farm, Walsall, **Milton Slumbers 30th** (541)
R.N. No. 2878.—MRS. M. C. INGE, Thorpe Hall, Tamworth, **Inge Queen Mab** 254954 (146).
H.C. No. 2882. C. No. 2881.

Class 358.—*Tamworth Sow, born in* 1937.

1st, No. 2888.—T. R. WILSON, Victoria House, Rufforth, Yorks., **Rufforth Rose** (439).
2nd, No. 2889.—T. R. WILSON, Rufforth, **Rufforth Stylish Lily** (438).
3rd, No. 2884.—MRS. CARLETON COWPER, Eamont, Penrith, **Eamont Neatness** (75).
R.N. No. 2886.—COL. C. J. H. WHEATLEY, Berkswell Hall, Coventry, **Berkswell Constance 28th** (1116).
H.C. No. 2887. C. No. 2885.

Berkshires.

No. 2891.—N.P.B.A. Silver Gilt Medal for the best Boar and Silver Challenge Bowl for the best Pig to E. CLIFTON-BROWN'S **Burnham Prim President.**
No. 2895.—R.N. for Silver Gilt Medal and R.N. for Silver Challenge Bowl to E. CLIFTON-BROWN'S **Burnham Griqua Prince.**
No. 2922.—N.P.B.A. Silver Gilt Medal for the best Sow to S. D. PLAYER'S **Whipling Lady 2nd.**
No. 2927.—R.N. for Silver Gilt Medal to LT.-COL. J. A. DUNNINGTON-JEFFERSON'S **Thicket Queen Lunn.**

Class 359.—*Berkshire Boar, born in or before* 1935.

1st, No. 2891.—E. CLIFTON-BROWN, Burnham Grove, Burnham, Bucks, **Burnham Prim President** 4123 (749).
2nd, No. 2892.—CHARLES R. DUNKLEY, Hill Crest, Harlestone, Northampton, **Warkton Musician** 3983 (41).
3rd, No. 2893.—THOMAS E. PREST, Chapel Farm, Swinton, Malton, **Highfield Resolute 3rd** (102).
R.N. No. 2890.—THE HON. MRS. C. BEHRENS, Swinton Grange, Malton, **Swinton Marius** 4187 (44).

Class 360.—*Berkshire Boar, born in* 1936, *before July* 1.

1st, No. 2895.—E. CLIFTON-BROWN, Burnham Grove, Burnham, Bucks., **Burnham Griqua Prince** 4117 (13).
2nd, No. 2898.—FRANK TOWNEND, Highfield, Moor Allerton, Leeds, **Highfield Royal Pygmalion 34th** 4161 (17).
3rd, No. 2896.—CHARLES R. DUNKLEY, Hill Crest, Harlestone, Northampton, **Warkton Able Musician** (63).

Class 361.—*Berkshire Boar, born in* 1936, *on or after July* 1.*

1st, 2906.—FRANK TOWNEND, Highfield, Moor Allerton, Leeds, **Chapel Keystone** 4129 (30).
2nd, No. 2904.—THOMAS E. PREST, Chapel Farm, Swinton, Malton, **Chapel Keystone 2nd** (30).

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* Prizes offered by the National Pig Breeders' Association.

3rd, No. 2900.—E. CLIFTON-BROWN, Burnham Grove, Burnham, Bucks., **Burnham Prim Monarch** (41).
4th, No. 2902.—LT.-COL. J. A. DUNNINGTON-JEFFERSON, D.S.O., Thicket Priory, York, **Thicket Ruler 2nd** (926).
R.N. No. 2907.—COL. G. E. WILKINSON, C.B.E., D.S.O., Dringhouses Manor, York, **Dringhouses Raeburn** (41).

Class 362.—*Berkshire Boar, born in* 1937.

1st, No. 2908.—E. CLIFTON-BROWN, Burnham Grove, Burnham, Bucks., **Burnham Primate** (103).
2nd, No. 2913.—S. D. PLAYER, Poulton Fields, Poulton, Fairford, **Whipling Keystone 2nd** (12).
3rd, No. 2911.—FRED W. GENTLE, Avenue House, Brandon, Suffolk, **Brandon Lad** (1).
R.N. No. 2914.—THOMAS E. PREST, Chapel Farm, Swinton, Malton, **Chapel Resolute 5th** (5).

Class 363.—*Berkshire Breeding Sow, born in or before* 1935.

1st, No. 2922.—S. D. PLAYER, Poulton Fields, Poulton, Fairford, **Whipling Lady 2nd 14462** (28).
2nd, No. 2918.—E. CLIFTON-BROWN, Burnham Grove, Burnham, Bucks., **Burnham Griqua Noravina 14554** (761).
3rd, No. 2923.—THOMAS E. PREST, Chapel Farm, Swinton, Malton, **Highfield Princess Royal 77th 14690** (83).
4th, No. 2924.—FRANK TOWNEND, Highfield, Moor Allerton, Leeds, **Dringhouses Princess Royal 14052** (97).
R.N. No. 2919.—LT.-COL. J. A. DUNNINGTON-JEFFERSON, D.S.O., Thicket Priory, York, **Thicket Ophelia Lunn 14414** (399).

Class 364.—*Berkshire Sow, born in* 1936, *before July* 1.

1st, No. 2927.—LT.-COL. J. A. DUNNINGTON-JEFFERSON, D.S.O., Thicket Priory, York, **Thicket Queen Lunn** (902).
2nd, No. 2931.—S. D. PLAYER, Poulton Fields, Poulton, Fairford, **Whipling Amelia 11th 14774** (46).
3rd, No. 2929.—LT.-COL. J. A. DUNNINGTON-JEFFERSON, D.S.O., Thicket Priory, York, **Thicket Queen Lunn 2nd** (903).
R.N. No. 2926.—E. CLIFTON-BROWN, Burnham Grove, Burnham, Bucks., **Burnham Griqua Gaylady** (14).

Class 365.—*Berkshire Sow, born in* 1936, *on or after July* 1.

1st, No. 2943.—THOMAS E. PREST, Chapel Farm, Swinton, Malton, **Chapel Margaret 21st 14322** (30).
2nd, No. 2944.—FRANK TOWNEND, Highfield, Moor Allerton, Leeds, **Chapel Margaret 20th 14620** (30).
3rd, No. 2937.—CHARLES R. DUNKLEY, Hill Crest, Harlestone, Northampton, **Warkton Moss Rose** (12).
4th, No. 2945.—COL. G. E. WILKINSON, C.B.E., D.S.O., Dringhouses Manor, York, **Dringhouses Estella** (61).
5th, No. 2935.—THE HON. MRS. C. BEHRENS, Swinton Grange, Malton **Swinton Sadie Margaret 2nd** (48).
R.N. No. 2938.—CHARLES R. DUNKLEY, Hill Crest, Harlestone, Northampton, **Warkton Moss Rose 2nd** (13).

Class 366.—*Berkshire Sow, born in* 1937.

1st, No. 2954.—S. D. PLAYER, Poulton Fields, Poulton, Fairford, **Whipling Amelia 20th** (6).
2nd, No. 2957.—FRANK TOWNEND, Highfield, Moor Allerton, Leeds. **Chapel Princess 2nd** (5).
3rd, No. 2956.—THOMAS E. PREST, Chapel Farm, Swinton. Malton, **Chapel Margaret 24th** (1).
4th, No. 2950.—CHARLES R. DUNKLEY, Hill Crest, Harlestone, Northampton, **Warkton Musical Pet 2nd** (27).
R.N. No. 2953.—FRED W. GENTLE, Avenue House, Brandon, Suffolk, **Brandon Noravina 2nd** (5).

Wessex Saddlebacks.

No. 2958.—N.P.B.A. Silver Gilt Medal for the best Boar and R.N. for Silver Challenge Cup for the best Pig to M. G. LING'S **Lavington Guardsman.**
No. 2965.—R.N. for Silver Gilt Medal to FRED W. GENTLE'S **Brandon David 6th.**
No. 2987.—N.P.B.A. Silver Gilt Medal for the best Sow and Silver Challenge Cup for the best Pig to FRED W. GENTLE'S **Brandon Sunbeam 11th.**
No. 2974.—R.N. for Silver Gilt Medal to G. A. COLE'S **Roadwater Colleen 8th.**

N.P.B.A. Special Prizes for best Groups of Wessex Saddleback Pigs bred by Exhibitor:

1st, £3. Nos. 2965, 2977, 2987, 2995, to FRED W. GENTLE'S **Brandon David 6th, Brandon Duchess 8th, Brandon Sunbeam 11th and Brandon Daybeam 7th.**

2nd, £2. Nos. 2972, 2979, 2989, 2998, to W. R. JACKSON'S **Chancellors Coronation, Chancellors Daybreak, Chancellors Rosaleen and Chancellors Viola.**

R.N. Nos. 2959, 2967, 2973, 2992, to H. L. BROOKSBANK'S **Sandrock Duke 3rd, Sandrock Presentation 3rd, Sandrock Frivolous 13th and Sandrock Gift 13th.**

Class 367.—*Wessex Saddleback Boar, born in or before* 1935.

1st, No. 2958.—M. G. LING, Ashe-Ingen Court. Ross-on-Wye, **Lavington Guardsman 3997** (31).

Class 368.—*Wessex Saddleback Boar, born in* 1936.*

1st, No. 2965.—FRED W. GENTLE, Avenue House, Brandon, Suffolk, **Brandon David 6th 4208** (133).

2nd, No. 2959.—H. L. BROOKSBANK, Sandrock, Tickhill, W. Yorks., **Sandrock Duke 3rd 4196** (5).

3rd, No. 2962.—R. P. CHESTER, Warnford Farm, Warnford, Southampton, **Ashe-Ingen Blue Prince 4036** (24).

R.N. No. 2964.—G. A. COLE, Sidbury Mills, Sidmouth, **Preston Viper 4170** (22).

Class 369.—*Wessex Saddleback Boar, born in* 1937.

1st, No. 2971.—F. W. GILBERT, The Manor, Chellaston, Derby, **Chellaston Coronet 2nd 4222** (6).

2nd, No. 2968.—G. A. COLE, Sidbury Mills, Sidmouth, **Sid-Vale Silver Wings 4237** (41).

3rd, No. 2967.—H. L. BROOKSBANK, Sandrock, Tickhill, W. Yorks., **Sandrock Presentation 3rd 4236** (11).

R.N. No. 2969.—FRED W. GENTLE, Avenue House, Brandon, Suffolk, **Brandon David 10th 4224** (221).

H.C. No. 2972.

Class 370.—*Wessex Saddleback Breeding Sow, born in or before* 1935.

1st, No. 2974.—G. A. COLE, Sidbury Mills, Sidmouth, **17875 Roadwater Colleen 8th** (10).

2nd, No. 2973.—H. L. BROOKSBANK, Sandrock, Tickhill, W. Yorks., **Sandrock Frivolous 13th 17583.**

3rd, No. 2979.—W. R. JACKSON, Chancellors Farm, Redhill, Wrington, Som., **Chancellors Daybreak 17270** (6).

R.N. No. 2978.—F. W. GILBERT, The Manor, Chellaston, Derby, **Chellaston Royal Druidess 3rd 17579** (5)

H.C. No. 2977.

Class 371.—*Wessex Saddleback Sow, born in* 1936.

1st, No. 2987.—FRED W. GENTLE, Avenue House, Brandon, Suffolk, **Brandon Sunbeam 11th 18227** (111).

2nd, No. 2986.—G. A. COLE, Sidbury Mills, Sidmouth, **Preston Shamrock 6th 18722** (29).

3rd, No. 2984.—R. P. CHESTER, Warnford Farm, Warnford, Southampton, **Roadwater Colleen 17th 18619** (15).

4th, No. 2990.—M. G. LING, Ashe-Ingen Court, Ross-on-Wye, **Ashe-Ingen Babble 5th 18756** (24).

R.N. No. 2985.—R. P. CHESTER, Warnford Farm, Warnford, Southampton, **Roadwater Colleen 18th 18620** (15).

H.C. Nos. 2989, 2991. C. No. 2988.

Class 372.—*Wessex Saddleback Sow, born in* 1937.

1st, No. 2998.—W. R. JACKSON, Chancellors Farm, Redhill, Wrington, Som., **Chancellors Viola 18924** (68).

2nd, No. 2995.—FRED W. GENTLE, Avenue House, Brandon, Suffolk, **Brandon Daybeam 7th 18922** (226).

3rd, No. 2996.—FRED W. GENTLE, Avenue House, **Brandon Daybeam 8th 18921** (224).

4th, No. 2993.—G. A. COLE, Sidbury Mills, Sidmouth, **Sid-Vale Rub Roy 18969** (43).

R.N. No. 2992.—H. L. BROOKSBANK, Sandrock, Tickhill, W. Yorks., **Sandrock Gift 13th 18968** (12).

H.C. No. 2997.

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* Prizes offered by the National Pig Breeder's Association.

Large Blacks.

No. 3003.—Large Black Pig Society's Challenge Cup for the best Boar to D. W. P. GOUGH'S Tartar Talisman.
No. 3017.—R.N. for Challenge Cup to W. W. WOLLAND'S Baydon Sundial.
No. 3033.—Large Black Pig Society's Challenge Cup for the best Sow to the EARL OF DARTMOUTH'S Patshull Princess 3rd.
No. 3045.—R.N. for Challenge Cup to F. W. GILBERT'S Chellaston Nightingale 3rd.
Nos. 3003, 3036, 3054. "Baydon" Silver Challenge Cup for the best group of Large Black Pigs to D. W. P. GOUGH'S Tartar Talisman, Pakenham Dawn 2nd and Pakenham Julia 8th.
Nos. 3008, 3034, 3045. R.N. for Challenge Cup to F. W. GILBERT'S Seawby Jehosophat 12th, Chellaston Bangle 15th and Chellaston Nightingale 3rd.

Class 373.—*Large Black Boar, born in or before* 1935.

1st, No. 3003.—D. W. P. GOUGH, Pakenham Manor, Bury St. Edmunds, Tartar Talisman L51.
2nd, No. 3001.—F. G. ALEXANDER, Laurel's Farm, Pulham Market, Diss, Norfolk, Depwade Duke N31.
3rd, No. 3006.—W. W. WOOLLAND, Baydon Manor, Ramsbury, Wilts., Pakenham Sundial 11th N165.
R.N. No. 3002.—THE EARL OF DARTMOUTH, Patshull House, Wolverhampton, Pakenham Tyne 1st M221.

Class 374.—*Large Black Boar, born in* 1936, *before July* 1.

1st, No. 3008.—F. W. GILBERT, The Manor, Chellaston, Derby, Seawby Jehosophat 12th P99.
2nd, No. 3007.—F. G. ALEXANDER, Laurels Farm, Pulham Market, Diss, Norfolk, Depwade Duke 3rd P125.
3rd, No. 3009.—FRANK SAINSBURY, Blunts Hall, Little Wratting, Haverhill, Kedington Rotation 12th P43.

Class 375.—*Large Black Boar, born in* 1936, *on or after July* 1.*

1st, No. 3017.—W. W. WOOLLAND, Baydon Manor, Ramsbury, Wilts., Baydon Sundial P331.
2nd, No. 3012.—WALTER D. CRAVEN, Upper Hurst, Hartington, Buxton, Hartington Prester John P317.
3rd, No. 3015.—D. W. P. GOUGH, Pakenham Manor, Bury St. Edmunds, Pakenham Realization 2nd P321.
R.N. No. 3014.—F. W. GILBERT, The Manor, Chellaston, Derby, Chellaston Good Boy P299.
H.C. No. 3013.

Class 376.—*Large Black Boar, born in* 1937.

1st, No. 3022.—D. W. P. GOUGH, Pakenham Manor, Bury St. Edmunds, Pakenham Some-day R35.
2nd, No. 3028.—W. W. WOOLLAND, Baydon Manor, Ramsbury, Wilts., Baydon King George 1st R73.
3rd, No. 3023.—D. W. P. GOUGH, Pakenham Manor, Bury St. Edmonds, Pakenham Whizbang 3rd R63.
4th, No. 3027.—W. W. WOOLLAND, Baydon Manor, Ramsbury, Wilts, Baydon King George R. 71.
R.N. No. 3021.—F. W. GILBERT, The Manor, Chellaston, Derby, Chellaston Black Boy R49.
H.C. Nos. 3018, 3019, 3025.

Class 377.—*Large Black Breeding Sow, born in or before* 1935.

1st, No. 3033.—THE EARL OF DARTMOUTH, Patshull House, Wolverhampton, Patshull Princess 3rd M776.
2nd, No. 3034.—F. W. GILBERT, The Manor, Chellaston, Derby, Chellaston Bangle 15th N776.
3rd, No. 3036.—D. W. P. GOUGH, Pakenham Manor, Bury St. Edmunds, Pakenham Dawn 2nd M1056.
4th, No. 3038.—FRANK SAINSBURY, Blunts Hall, Little Wratting, Haverhill, Kedington Dora 4th N182.
5th, No. 3041.—W. W. WOOLLAND, Baydon Manor, Ramsbury, Wilts., Baydon Jubilee Nightingale 103rd N824.
R.N. No. 3035.—F. W. GILBERT, The Manor, Chellaston, Derby, Chellaston Lustrous Pearl 2nd M584.
H.C. No. 3029.

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* Prizes offered by the Large Black Pig Society.

Class 378.—*Large Black Sow, born in 1936, before July 1.*

1st, No. 3045.—F. W. GILBERT, The Manor, Chellaston, Derby, **Chellaston Nightingale 3rd P96.**
2nd, No. 3046.—D. W. P. GOUGH, Pakenham Manor, Bury St. Edmunds, **Pakenham Rumour 1st P78.**
3rd, No. 3043.—THE EARL OF DARTMOUTH, Patshull House, Wolverhampton, **Patshull Princess 10th P1130.**
R.N. No. 3047.—FRANK SAINSBURY, Blunts Hall, Little Wratting, Haverhill, **Kedington Radiance 23rd P100.**
H.C. Nos. 3042, 3049.

Class 379.—*Large Black Sow, born in 1936, on or after July 1.*

1st, No. 3051.—WALTER D. CRAVEN, Upper Hurst, Hartington, Buxton, **Hartington Iolanthe 4th P796.**
2nd, No. 3053.—F. W. GILBERT, The Manor, Chellaston, Derby, **Baydon Nightingale 114th P1154.**
3rd, No. 3055.—T. F. JAMES, Warren Farm, Culham, Abingdon, Berks., **Treluckey Duchess 26th P460.**
R.N. No. 3054.—D. W. P. GOUGH, Pakenham Manor, Bury St. Edmunds, **Pakenham Julia 8th P1148.**
H.C. Nos. 3050, 3052, 3056.

Class 380.—*Large Black Sow, born in 1937.*

1st, No. 3066.—W. W. WOOLLAND, Baydon Manor, Ramsbury, Wilts., **Baydon Nightingale 110th R196**
2nd, No. 3063.—D. W. P. GOUGH, Pakenham Manor, Bury St. Edmunds, **Pakenham Jewel 2nd R112.**
3rd, No. 3060.—THE EARL OF DARTMOUTH, Patshull House, Wolverhampton, **Patshull Ducat 41st R150.**
4th, No. 3059.—WALTER D. CRAVEN, Upper Hurst, Hartington, Buxton, **Hartington Tosca 17th R106.**
R.N. No. 3058.—C. J. BURROWS, Songar Grange, Wootton Wawen, Birmingham, **Songar Princess 1st R48.**
H.C. Nos. 3061, 3062.

Gloucestershire Old Spots.

No. 3069.—Silver Challenge Cup for the best Boar and Perpetual Silver Challenge Cup for the best Pig to J. F. WRIGHT'S **Solihull Bob 7th.**
No. 3070.—R.N. for Silver Challenge Cup to J. F. WRIGHT'S **Solihull Bonzo.**
No. 3078.—Perpetual Silver Challenge Cup for the best Sow and R.N. for Perpetual Silver Challenge Cup for the best Pig to LT.-COL. C. E. TURNER'S **Solihull Bonetta 14th.**
No. 3082.—R.N. for Perpetual Silver Challenge Cup for the best Sow to SHERRIFF & SONS' **Nashes Duchess 62nd.**

Class 381.—*Gloucestershire Old Spots Boar, born in or before 1935.*

1st, No. 3069.—J. F. WRIGHT, Olton Farm, Solihull, Warwickshire, **Solihull Bob 7th 6024.**
2nd, No. 3068.—SHERRIFF & SONS, Lemsford, Welwyn Garden, Herts., **Nashes Duke 35th 6041.**

Class 382.—*Gloucestershire Old Spots Boar, born in 1936.**

1st, No. 3070.—J. F. WRIGHT, Olton Farm, Solihull, Warwickshire, **Solihull Bonzo 6064.**

Class 383.—*Gloucestershire Old Spots Boar, born in 1937.*

1st, No. 3073.—J. F. WRIGHT, Olton Farm, Solihull, Warwickshire, **Solihull Bob 15th 6059.**
2nd, No. 3072.—SHERRIFF & SONS, Lemsford, Welwyn Garden, Herts., **Nashes Duke 38th 6065.**
3rd, No. 3074.—J. F. WRIGHT, Olton Farm, Solihull, Warwickshire, **Solihull Bob 16th 6060.**
R.N. No. 3071.—S. C. FLOOK, Tynings Farm, Codrington, Chipping Sodbury, **Tyning Michael 6066.**

Class 384.—*Gloucestershire Old Spots Breeding Sow, born in or before 1935.*

1st, No. 3078.—LT.-COL. C. E. TURNER, D.S.O., Oldown, Tockington, Glos., **Solihull Bonetta 14th Z883.**
2nd, No. 3079.—J. F. WRIGHT, Olton Farm, Solihull, Warwickshire, **Solihull Bonetta 11th Z823.**

* Prize offered by the Gloucestershire Old Spots Pig Society.

3rd, No. 3075.—S. C. FLOOK, Tynings Farm, Codrington, Chipping Sodbury, **Tyning Cream 10th Z865.**

R.N. No. 3080.—J. F. WRIGHT, Olton Farm, Solihull, Warwickshire, **Solihull Josephine 25th Z812.**

Class 385.—*Gloucestershire Old Spots Sow, born in* 1936.

1st, No. 3082.—SHERRIFF & SONS, Lemsford, Welwyn Garden, Herts., **Nashes Duchess 62nd Z896.**

2nd, No. 3085.—J. F. WRIGHT, Olton Farm, Solihull, Warwickshire, **Solihull Primula 2nd Z952.**

3rd, No. 3083.—LT.-COL. C. E. TURNER, D.S.O., Oldown, Tockington, Glos., **Alkington Bonetta Z954.**

R.N. No. 3084.—J. F. WRIGHT, Olton Farm, Solihull, Warwickshire, **Solihull Primula 1st Z951.**

Class 386.—*Gloucestershire Old Spots Sow, born in* 1937.

1st, No. 3087.—SHERRIFF & SONS, Lemsford, Welwyn Garden, Herts., **Nashes Duchess 63rd Z953.**

2nd, No. 3089.—J. F. WRIGHT, Olton Farm, Solihull, Warwickshire, **Solihull Josephine 31st Z947.**

3rd, No. 3086.—S. C. FLOOK, Tynings Farm, Codrington, Chipping Sodbury, **Tyning Cream 13th Z958.**

R.N. No. 3088.—J. F. WRIGHT, Olton Farm, Solihull, Warwickshire, **Solihull Josephine 30th Z946.**

Cumberlands.

No. 3100.—Cumberland Pig Breeders' Association's Silver Challenge Cup for the best Pig to W. BAINBRIDGE & SONS' **Fairway Sally.**
No. 3106.—R.N. for Silver Challenge Cup to W. BAINBRIDGE & SONS' **Tamar.**

Class 387.—*Cumberland Boar, born in or before* 1936.

1st, No. 3090.—W. BAINBRIDGE & SONS, Brougham Home Farm, Eamont Bridge, Penrith, **Dockray Quinine 9883 (W.D.G.Q.2).**

2nd, No. 3094.—WYNDHAM T. VINT, Terrys, Ormside, Appleby, **Grinsdale Express 10091 (O.L.P.Q.11).**

3rd, No. 3092.—RALPH MILLNER, Angerton Kirkbride, Carlisle, **Aikton House Ideal 10086 (G.D.I.S.3).**

R.N. No. 3091.—W. BAINBRIDGE & SONS, Brougham Home Farm, **Woodside Onward 9639 (B.W.W.O.1).**
H.C. No. 3093.

Class 388.—*Cumberland Boar, born in* 1937.

1st, No. 3095.—W. BAINBRIDGE & SONS, Brougham Home Farm, Eamont Bridge, Penrith, **Woodside Talisman (B.W.W.T.2).**
2nd, No. 3098.—WYNDHAM T. VINT, Terrys, Ormside, Appleby, **Aikton House Donald (G.D.I.T.3).**
3rd, No. 3097.—RALPH MILLNER, Angerton, Kirkbride, Carlisle, **Fairway Theo (M.L.N.T.11).**
R.N. No. 3096.—W. BAINBRIDGE & SONS, Brougham Home Farm, Eamont Bridge, Penrith, **Woodside Triumph (B.W.W.T.1).**
H.C. No. 3099.

Class 389.—*Cumberland Sow, born in or before* 1936.

1st, No. 3100.—W. BAINBRIDGE & SONS, Brougham Home Farm, Eamont Bridge, Penrith, **Fairway Sally (M.L.N.S.25).**
2nd, No. 3101.—W. BAINBRIDGE & SONS, Brougham Home Farm, **Lonning Susie (G.H.L.S.9).**
3rd, No. 3102.—RALPH MILLNER, Angerton, Kirkbride, Carlisle, **Fairway Norma 9994 (M.L.N.Q.4).**
R.N. No. 3104.—WYNDHAM T. VINT, Terrys, Ormside, Appleby, **Aikton House Queen 9977 (G.D.I.Q.18).**
H.C. No. 3105.

Class 390.—*Cumberland Sow, born in* 1937.*

1st, No. 3106.—W. BAINBRIDGE & SONS, Brougham Home Farm, Eamont Bridge, Penrith, **Tamar (P.T.4).**
2nd, No. 3107.—W. BAINBRIDGE & SONS, Brougham Home Farm, **Tottie (P.T.3).**
3rd, No. 3109.—WYNDHAM T. VINT, Terrys, Ormside, Appleby, **Aikton House Doreen (G.D.I.T.6)**
R.N. No. 3108.—RALPH MILLNER, Angerton, Kirkbride, Carlisle, **Fairway Therresa (M.L.N.T.17)**
H.C. No. 3110.

* Prizes offered by the Cumberland Pig Breeders' Association.

Essex.

No 3166.—Essex Pig Society's Chapmion Silver Cup for the best Pig to HAROLD H. BOWSER'S Magdalen Pride 47th.
No. 3161.—R.N. for Champion Silver Cup to W. DENNIS & SONS' Kirton Alma 3rd.
Nos. 3111, 3166, 3187. "Sedgemere" Silver Challenge Cup for the best group of Essex Pigs to HAROLD H. BOWSER'S Huskards Wesley Nevill 2nd, Magdalen Pride 47th and Magdalen Pride 75th.
Nos. 3181, 3201, 3202.—R.N. for Challenge Cup to WILLIAM RITCHIE'S Roothing Female 41st, Roothing Biddy 50th and Roothing Biddy 51st.

Class 391.—*Essex Boar, born in or before* 1935.*

1st, No. 3111.—HAROLD H. BOWSER, Swineshead House, Boston, Lincs., Huskards Weeley Nevill 2nd 4431.
2nd, No. 3116.—WILLIAM RITCHIE, Marks Hall, Margaret Roding, Dunmow, Truelovea Orlop 4615.
3rd, No. 3114.—W. DENNIS & SONS, LTD., Kirton, Boston, Lincs., Becking Duke 4167.
R.N. No. 3117.—TINNEY & HITCHCOCK, Church End, Rickling, Newport, Essex, Kirton Duke 7th 4897.
H.C. No. 3115. C. No. 3112.

Class 392.—*Essex Boar, born in* 1936, *before July* 1.

1st, No. 3120.—E. T. BAILEY, Boggis, Roxwell, Chelmsford, Cressing Grand Duke 35th 4795.
2nd, No. 3121.—W. DENNIS & SONS, LTD., Kirton, Boston, Lincs., Kirton Duke 14th 5061.
3rd, No. 3123.—G. E. GITTUS, Fentons, Barrow, Bury St. Edmunds, Saxham Jamie 5195.

Class 393.—*Essex Boar, born in* 1936, *on or after July* 1.

1st, No. 3133.—W. DENNIS & SONS, LTD., Kirton, Boston, Lincs., Kirton Kaiser 3rd 5175.
2nd, No. 3126.—A. HERBERT CARTER, Tydd Manor, Wisbech, Tydd Gay Lad 5157.
3rd, No. 3128.—A. HERBERT CARTER, Tydd Manor, Tydd Jay 5161.
4th, No. 3129.—A. HERBERT CARTER, Tydd Manor, Tydd Joey 5163.
R.N. No. 3135.—WILLIAM RITCHIE, Marks Hall, Margaret Roding, Dunmow, Roothing Grand Duke 7th 5187.
H.C. No. 3132. C. No. 3136.

Class 394.—*Essex Boar, born in* 1937.

1st, No. 3150.—MRS. FRANK HILDER, Huskards, Ingatestone, Huskards John 3rd 5171.
2nd, No. 3146.—W. DENNIS & SONS, LTD., Kirton, Boston, Lincs., Kirton Emblem 7th 5147.
3rd, No. 3140.—G. E. GITTUS, Barrow, Bury St. Edmunds, Saxham Premier 5263.
4th, No. 3141.—A. HERBERT CARTER, Tydd Manor, Wisbech, Tydd Hero 5159.
5th, No. 3152.—WILLIAM RITCHIE, Marks Hall, Margaret Roding, Dunmow, Roothing Orlop 5189.
R.N. No. 3145.—W. DENNIS & SONS, LTD., Kirton, Boston, Lincs., Kirton Emblem 4th 5141.
H.C. No. 3148. C. No. 3139.

Class 395.—*Essex Breeding Sow, born in or before* 1935.

1st, No. 3161.—W. DENNIS & SONS, LTD., Kirton, Boston, Lincs., Kirton Alma 3rd 24888.
2nd, No. 3154.—HAROLD H. BOWSER, Swineshead House, Boston, Lincs., Magdalen Pride 20th 22110.
3rd, No. 3157.—A. HERBERT CARTER, Tydd Manor, Wisbech, Wesley Prim 7th 23262.
4th, No. 3156.—A. HERBERT CARTER, Tydd Manor, Trueloves Nina 23518.
R.N. No. 3165.—TINNEY & HITCHCOCK, Church End, Rickling, Newport, Essex, Roothing Female 37th 25954.
H.C. No. 3164. C. No. 3159.

Class 396.—*Essex Sow, born in* 1936, *before July* 1.

1st, No. 3166.—HAROLD H. BOWSER, Swineshead House, Boston, Lincs., Magdalen Pride 47th 26166.
2nd, No. 3181.—WILLIAM RITCHIE, Marks Hall, Margaret Roding, Dunmow, Essex, Roothing Female 41st 27122.
3rd, No. 3170.—A. HERBERT CARTER, Tydd Manor, Wisbech, Tydd Duchess 4th 26999.
4th, No. 3187.—HAROLD H. BOWSER, Swineshead House, Boston, Lincs., Magdalen Pride 58th 26296.

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* Prizes offered by the Essex Pig Society.

5th, No. 3179.—W. DENNIS & SONS, LTD., Kirton, Boston, Lincs., **Kirton Treasure 25558.**

R.N. No. 3183.—TINNEY & HITCHCOCK, Church End, Rickling, Newport, Essex, **Kirton Grand Duchess 6th 27866.**

H.C. No. 3168. C. No. 3182.

Class 397.—*Essex Sow, born in* 1936, *on or after July* 1.*

1st, No. 3187.—HAROLD H. BOWSER, Swineshead House, Boston, Lincs., **Magdalen Pride 75th 28280.**

2nd, No. 3201.—WILLIAM RITCHIE, Marks Hall, Margaret Roding, Dunmow, Essex, **Roothing Biddy 50th 27110.**

3rd, No. 3202.—WILLIAM RITCHIE, Marks Hall, **Roothing Biddy 51st 27112.**

4th, No. 3186.—HAROLD H. BOWSER, Swineshead House, Boston, Lincs., **Magdalen Pride 74th 28278.**

5th, No. 3200.—MRS. FRANK HILDER, Huskards, Ingatestone, **Potters Bess 50th 27314.**

R.N. No. 3197.—W. DENNIS & SONS, LTD., Kirton, Boston, Lincs., **Kirton Charlotte 3rd 28142.**

H.C. No. 3205. C. No. 3189.

Class 398.—*Essex Sow, born in* 1937.

1st, No. 3206.—ERIC T. BAILEY, Boggis, Roxwell, Chelmsford, **Roxwell Queen 3rd 28330.**

2nd, No. 3213.—CAVAGHAN & GRAY, LTD., Harraby, Carlisle, **Greenwood Pride 7th 28654.**

3rd, No. 3218.—W. DENNIS & SONS, LTD., Kirton, Boston, Lincs., **Kirton Faithful 5th 28010.**

4th, No. 3223.—WILLIAM RITCHIE, Marks Hall, Margaret Roding, Dunmow, Essex, **Roothing Female 45th 28126.**

5th, No. 3210.—A. HERBERT CARTER, Tydd Manor, Wisbech, **Tydd Duchess 10th 28208.**

R.N. No. 3217.—W. DENNIS & SONS, LTD., Kirton, Boston, Lincs., **Kirton Carrie 9th 28006.**

H.C. No. 3209. C. No. 3219.

Long White Lop-Eared.

No. 3224.—National Long White Lop-eared Pig Society's Champion Silver Medal for the best Boar and "Risingholme" Silver Challenge Cup for the best Pig to G. H. EUSTICE'S **Bezurrel Ben.**

No. 3231.—R.N. for Champion Silver Medal to W. J. WESTLAKE'S **Godwell Baconer 8th.**

No. 3234.—National Long White Lop-eared Pig Society's Champion Silver Medal for the best Sow and R.N. for "Risingholme" Silver Challenge Cup for the best Pig to W. H. NEAL'S **Yealmpstone Dainty 9th.**

No. 3238.—R.N. for Champion Silver Medal to H. R. JASPER'S **Petherwin No. 3 of 1936.**

Class 399.—*Long White Lop-Eared Boar, born in or before* 1936.

1st, No. 3224.—G. H. EUSTICE, Bezurrel, Gwinear, Hayle, **Bezurrel Ben 2832.**

2nd, No. 3227.—W. J. WESTLAKE, Godwell, Ivybridge, **Godwell Admiral 2568.**

3rd, No. 3226.—W. H. NEAL, Walreddon Farm, Tavistock, **Yealmpstone Gay Boy 19th 2958.**

R.N. No. 3225.—H. R. JASPER, East Petherwin Farm, South Petherwin, Launceston, **Petherwin Bacon Boy 3014.**

Class 400.—*Long White Lop-Eared Boar, born in* 1937.

1st, No. 3231.—W. J. WESTLAKE, Godwell, Ivybridge, **Godwell Baconer 8th 3002.**

2nd, No. 3230.—HENRY J. KINGWELL, Great Aish, South Brent, S. Devon, **Devonshire A. B. C. 3018.**

3rd, No. 3229.—H. R. JASPER, East Petherwin Farm, South Petherwin, Launceston, **Petherwin Ben 1st of 1937 3016.**

R.N. No. 3228.—G. H. EUSTICE, Bezurrel, Gwinear, Hayle, **Bezurrel Ben 12th.**

Class 401.—*Long White Lop-Eared Breeding Sow, born in or before* 1935.

1st, No. 3234.—W. H. NEAL, Walreddon Farm, Tavistock, **Yealmpstone Dainty 9th 8023.**

2nd, No. 3233.—H. R. JASPER, East Petherwin Farm, South Petherwin, Launceston, **Petherwin No. 4 of 1932 7231.**

3rd, No. 3232.—G. H. EUSTICE, Bezurrel, Gwinear, Hayle, **Bezurrel Ruby 6th 7861.**

R.N. No. 3235.—W. J. WESTLAKE, Godwell, Ivybridge, **Godwell Duchess 8th 8071.**

Class 402.—*Long White Lop-Eared Sow, born in* 1936.

1st, No. 3238.—H. R. JASPER, East Petherwin Farm, South Petherwin, Launceston, **Petherwin No. 3 of 1936 8385.**

2nd, No. 3237.—H. R. JASPER, East Petherwin Farm, **Petherwin No. 1 of 1936 8263.**

3rd, No. 3236.—G. H. EUSTICE, Bezurrel, Gwinear, Hayle, **Bezurrel Mona 38th 8267.**

R.N. No. 3239.—W. H. NEAL, Walreddon Farm, Tavistock, **Petherwin No. 2 of 1936 8265.**

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* 1st, 2nd and 3rd prizes offered by the **Essex Pig Society.**

Class 403.—*Long White Lop-Eared Sow, born in* 1937.

1st, No. 3243.—HENRY J. KINGWELL, Great Aish, South Brent, S. Devon, Devonshire Duchess 122nd 8397.
2nd, No. 3244.—W. J. WESTLAKE, Godwell, Ivybridge, Godwell Duchess 13th 8369.
3rd, No. 3240.—G. H. EUSTICE, Bezurrel, Gwinear, Hayle, Bezurrel Mary 58th 8377.
R.N. No. 3242.—HENRY J. KINGWELL, Great Aish, South Brent, S. Devon, Devonshire Duchess 120th 8391.

Welsh.

Class 404.—*Welsh Boar, born in or before* 1936.

1st, No. 3245.—CHARLES L. COXON, Milton, Pembridge, Leominster, Dinam Horace 79 (B.U. 669).
2nd, No. 3249.—WYNDHAM T. VINT, Thorn Cottage, Wroot, Doncaster, Prestatyn Gay Boy 6th 147 (D.U. 106).

Class 405.—*Welsh Boar, born in* 1937.

1st, No. 3250.—G. H. EUSTICE, Bezurrel, Gwinear, Hayle, Bezurrel Albion 3rd 398 (66).

Class 406.—*Welsh Breeding Sow, born in or before* 1935.

1st, No. 3256.—R. EWART OWEN, Tanlan Hall Home Farm, Prestatyn, Prestatyn Flirt 269 (D.U.85).
2nd, No. 3255.—R. EWART OWEN, Prestatyn, Prestatyn Flame 268 (D.U. 84).
3rd, No. 3254.—G. H. EUSTICE, Bezurrel, Gwinear, Hayle, Dinam Hopeful 15th 910 (B.U. 1086).
R.N. No. 3258.—W. WHITLEY, Barton Pines, Paignton, Welstor Girlie 426 (W.W. 18).
C. No. 3257.

Class 407.—*Welsh Sow, born in* 1936.*

1st, No. 3261.—R. EWART OWEN, Tanlan Hall Home Farm, Prestatyn, Prestatyn Ida 1st 907 (D.U. 144).
2nd, No. 3262.—WYNDHAM T. VINT, Thorn Cottage, Wroot, Doncaster, Emlyn Fairy 924 (V.T. 214).
3rd, No. 3263.—WYNDHAM T. VINT, Wroot, Emlyn Fairy 2nd 925 (V.T. 215).
R.N. No. 3265.—W. WHITLEY, Barton Pines, Paignton, Welstor Jenny 948 (W.W. 177).

Class 408.—*Welsh Sow, born in* 1937.

1st, No. 3268.—R. EWART OWEN, Tanlan Hall Home Farm, Prestatyn, Prestatyn Dilys 2nd 1048 (D.U. 358).
2nd, No. 3267.—R. EWART OWEN, Prestatyn, Prestatyn Dilys 1047 (D.U. 357).
3rd, No. 3266.—G. H. EUSTICE, Bezurrel, Gwinear, Hayle, Bezurrel Nora 7th 1030 (G.H.E. 61).
R.N. No. 3269.—WYNDHAM T. VINT, Thorn Cottage, Wroot, Doncaster, Emlyn Betty 1038 (V.T. 294).

POULTRY.

By "Cock" and "Hen" are meant birds hatched previous to November 1, 1936; and by "Cockerel" and "Pullet" are meant birds hatched on or after November 1, 1936.

The Prizes are as follows: First Prize, 30s.; Second Prize, 20s.; Third Prize, 10s.; Fourth Prize, 5s.

"P.F." stands for "Poultry Farm."

Classes omitted were cancelled owing to insufficient entries.

Class 409.—*Dorking Cock or Cockerel.*

1st, No. 3.—S. OATEY, Chacewater, Truro.
2nd, No. 4.—W. G. WATSON, Rusper Road, Horsham.
3rd, No. 7, 4th, No. 2, & R.N., No. 5.—A. J. MAJOR, Ditton, Langley, Bucks.
H.C. No. 6.

Class 410.—*Dorking Hen or Pullet.*

1st, No. 12.—S. OATEY, Chacewater, Truro.
2nd, No. 9, & 3rd, No. 11.—A. J. MAJOR, Ditton, Langley, Bucks.
4th, No. 8.—W. WALKER, Skinners Steps, Cupar, Fife.
R.N. No. 10.—W. G. WATSON, Rusper Road, Horsham.
H.C. No. 13.

* Prizes offered by the Welsh Pig Society.

Class 412.—*Croad Langshan Hen or Pullet.*

1st, & Croad Langshan Club's Special Prize, No. 16.—R. ANTHONY, Euxton, Chorley, Lancs.
2nd, & R.N. for Special Prize, No. 15.—HAROLD CHURCH, Godshill, Fordingbridge, Hants.
3rd, No. 14, & **4th,** No. 17.—C. F. BARKER, 51, Waverley, Brays Lane, Coventry.

Class 415.—*Light Sussex Cock.*

1st, & R.N. for "Crawshay" Cup, No. 22, & **3rd,** No. 19.—MRS. A. E. JENKINS, Wherwell P.F., Longparish, Andover.
2nd, No. 18.—LORD KEMSLEY, Farnham Park P.F., Farnham Royal, Bucks.
4th, No. 21.—F. FARR, St. Anne's Villa, Elswick, Kirkham.
R.N. No. 20.—H. UNDERWOOD & SON, Mowshurst P.F., Edenbridge.

Class 416.—*Light Sussex Hen.*

1st, No. 30, & **R.N.,** No. 27.—W. A. WEBB, The Bungalow, Signal Hayes Road, Walmley, Birmingham.
2nd, No. 23, & **3rd,** No. 29.—LORD KEMSLEY, Farnham Park P.F., Farnham Royal, Bucks.
4th, No. 24.—H. UNDERWOOD & SON, Mowshurst P.F., Edenbridge.
H.C. Nos. 25, 28. **C.** No. 26.

Class 417.—*Light Sussex Cockerel.*

1st, & "Crawshay" Memorial Cup, No. 31.—COL. D. A. CHAYTOR, Pooley Hall, Polesworth, Tamworth.
2nd, No. 32, & **4th,** No. 37.—LORD KEMSLEY, Farnham P.F., Farnham Royal, Bucks.
3rd, No. 35, & **R.N.,** No. 39.—MRS. A. E. JENKINS, Wherwell P.F., Longparish, Andover.
H.C. Nos. 34, 38. **C.** No. 33.

Class 418.—*Light Sussex Pullet.*

1st, No. 49, & **2nd,** No. 45.—MRS. A. E. JENKINS, Wherwell P.F., Longparish, Andover.
3rd, No. 40.—COL. D. A. CHAYTOR, Pooley Hall, Polesworth, Tamworth.
4th, No. 41.—LORD KEMSLEY, Farnham Park P.F., Farnham Royal, Bucks.
R.N. No. 43.—W. J. GREEN, Hailsham.
H.C. Nos. 42, 44. **C.** No. 47.

Class 419.—*Speckled Sussex Cock or Cockerel.*

1st, No. 50, **2nd,** No. 52, & **3rd,** No. 54.—LORD KEMSLEY, Farnham Park P.F., Farnham Royal, Bucks.
4th, No. 51.—CAPT. T. M. WHITTAKER, Pen-y-Bryn Farm, Portmadoc.

Class 420.—*Speckled Sussex Hen or Pullet.*

1st, No. 57, & **2nd,** No. 55.—LORD KEMSLEY, Farnham Park P.F., Farnham Royal, Bucks.
3rd, No. 56.—CAPT. T. M. WHITTAKER, Pen-y-Bryn Farm, Portmadoc.

Class 421.—*Sussex Any Other Colour Cock or Cockerel.*

1st, No. 60, & **2nd,** No. 62.—J. DUMBLETON, Sheen Croft, Didcot.
3rd, No. 63.—LORD KEMSLEY, Farnham Park P.F., Farnham Royal, Bucks.
4th, No. 61.—GREENHOW & HARTLEY, Galaberry P.F., Annan.

Class 422.—*Sussex Any Other Colour Hen or Pullet.*

1st, No. 68, & **3rd,** No. 64.—J. DUMBLETON, Sheen Croft, Didcot.
2nd, No. 66.—F. J. MARSTON, The Biddenden P.F., Biddenden, Kent.
4th, No. 67.—GREENHOW & HARTLEY, Galaberry P.F., Annan.

Class 425.—*Gold or Silver Laced Wyandotte Cock or Cockerel.*

1st, No. 72, & **2nd,** No. 70.—N. J. THOMAS, Harvose, Grampound, Cornwall.
3rd, No. 69, & **4th,** No. 71.—H. SPENSLEY, Oaks Farm, Menston-in-Wharfedale.

Class 426.—*Gold or Silver Laced Wyandotte Hen or Pullet.*

1st, No. 76.—R. ANTHONY, Euxton, Chorley, Lancs.
2nd, No. 73.—R. WHITEHEAD, Bonehill, Tamworth.
3rd, No. 74.—MISS E. T. LONGE, Abbot's Hall, Stowmarket.
4th, No. 77, & **R.N.,** No. 75.—H. SPENSLEY, Oaks Farm, Menston-in-Wharfedale.

Class 427.—*Wyandotte Any Other Colour Cock or Cockerel.*

1st, No. 84.—R. HARGREAVES, Abbeydene P.F., Whalley, Lancs.
2nd, No. 85.—F. MACHIN, New Pool Villa, Knypersley, Biddulph, Stoke-on-Trent.
3rd, No. 82.—H. WHITLEY, Primley, Paignton.
4th, No. 81.—J. G. MORTEN, Pentrich, Derby.
R.N. No. 79.—E. CLIFTON-BROWN, Burnham Grove, Burnham, Bucks.
H.C. No. 78. **C.** No. 80.

Class 428.—*Wyandotte Any Other Colour Hen or Pullet.*

1st, No. 90.—R. ANTHONY, Buxton, Chorley, Lancs.
2nd, No. 88.—W. H. LEESON, 91, Harnall Lane East, Coventry.
3rd, No. 89.—J. WHARTON, Honeycott Farm, Hawes, Yorks.
4th, No. 91.—R. HARGREAVES, Abbeydene P.F., Whalley, Lancs.

R.N. No. 92.—E. CLIFTON-BROWN, Burnham Grove, Burnham, Bucks.
H.C. No. 86.

Class 431.—*Black Orpington Cock or Cockerel.*

1st, No. 96, & 2nd, No. 94.—JOHN BURDETT, 1, Lake Bank Terrace, Wingate, Co. Durham.
3rd, No. 95.—MISS N. SHANKS, Stetchworth, Newmarket.
4th, No. 93.—ARTHUR SNELGROVE, Scholar Green, Stoke-on-Trent.

Class 433.—*Orpington Any Other Colour Cock or Cockerel.*

1st, No. 99.—WILD BROS., Abbey P.F., Kidwelly.
2nd, No. 101.—J. D. KAY, Stetchworth, Newmarket.
3rd, No. 102.—H. WHITLEY, Primley, Paignton.
4th, No. 100.—T. TRIGG, The Oaks, Anthill, Denmead, Cosham, Hants.

R.N. No. 97.—W. G. VIVIAN & SON, 5, Stanhope Square, Holsworthy, Devon.

Class 434.—*Orpington Any Other Colour Hen or Pullet.*

1st, No. 104.—H. WHITLEY, Primley, Paignton.
2nd, No. 106, & 4th, No. 108.—T. TRIGG, The Oaks, Anthill, Denmead, Cosham, Hants.
3rd, No. 107.—J. D. KAY, Stetchworth, Newmarket.

R.N., No. 105.—WILD BROS., Abbey P.F., Kidwelly.
H.C. No. 103.

Class 435.—*Black Barnevelder Cock or Cockerel.*

1st & British Black Barnevelder Club's Special Prize, No. 112, & 3rd, No. 114.—HARRY FOX, International Poultry Yards, Matlock.
2nd, No. 111.—WALTER C. PAYNE, The Chalet, Weston, Hitchin.
4th, No. 110.—T. GRAHAM, Thornhill P.F., Long Marton, Westmorland.

H.C. No. 115. C. No. 113.

Class 436.—*Black Barnevelder Hen or Pullet.*

1st & British Black Barnevelder Club's Special Prize, No. 118.—T. CLOUGH, The Poultry Farm, Gawsworth, Macclesfield.
2nd, No. 119.—O. E. OAKLEY, Post Office, Weston, Hitchin.
3rd, No. 120.—WALTER C. PAYNE, The Chalet, Weston, Hitchin.
4th, No. 121.—HARRY FOX, International Poultry Yards, Matlock.

H.C. No. 117.

Class 438.—*Barnevelder Any Other Colour Hen or Pullet.*

1st & British Barnevelder Club's Special Prize, No. 126.—A. WHITTON, Aiskew, Bedale.
2nd, No. 123.—W. BINNIE & SON, Garth House, Denny, Stirlingshire.
3rd, No. 125.—J. E. H. & MISS VENNING, Trefrank, St. Clether, Launceston.
4th, No. 124.—H. Rivers, 195, Croydon Road, Anerley.

H.C. No. 127. C. No. 129.

Class 439.—*Rhode Island Red Cock.*

1st & Rhode Island Red Club's Special Prize, No. 135.—SIR HARRY HAGUE, Ovaltine Farm, King's Langley.
2nd & Reserve Special Prize, No. 130.—LORD GREENWAY, Stanbridge Earls P.F., Edenbridge.
3rd, No. 140.—HARRY FOX, International Poultry Yards, Matlock.
4th, No. 136.—JOHN KAY, Alderwood, Edenfield, Manchester.

R.N. No. 141.—RICHARD MOORE, The Orchards, Long Sutton, Wisbech.
H.C. Nos. 132, 137. C. No. 143.

Class 440.—*Rhode Island Red Hen.*

1st & Reserve Special Prize, No. 148.—JOHN KAY, Alderwood, Edenfield, Manchester.
2nd, No. 146.—S. TUNNICLIFFE, The Cottage, Wigginton Road, Tamworth.
3rd, No. 144.—LORD GREENWAY, Stanbridge Earls P.F., Edenbridge.
4th, No. 151.—RICHARD MOORE, The Orchards, Long Sutton, Wisbech.

R.N. No. 147.—J. G. WILLIAMSON, Chester Road, Middlewich.
H.C. No. 145. C. No. 150.

Class 441.—*Rhode Island Red Cockerel.*

1st, No. 154.—J. G. WILLIAMSON, Chester Road, Middlewich.
2nd, No. 152.—LORD GREENWAY, Stanbridge Earls P.F., Edenbridge.
3rd, No. 155.—G. H. MUZZLEWHITE, Redlands, Tavistock.
4th, No. 157.—RICHARD MOORE, The Orchards, Long Sutton, Wisbech.

R.N. No. 156.—F. RUSHFORD & SON, Etherley House, Wind Mill P.F., Bishop Auckland
C. No. 159.

Class 442.—*Rhode Island Red Pullet.*

1st & Rhode Island Red Club's Special Prize, No. 162, 2nd, No. 163, & R.N., No. 166.—RICHARD MOORE, The Orchards, Long Sutton, Wisbech.
3rd, No. 168.—FRANK H. PAGE, Woodlands, Gt. Horkesley, Colchester.
4th, No. 167.—J. G. WILLIAMSON, Chester Road, Middlewich.

H.C. No. 164. C. No. 160.

Class 443.—*Barred Plymouth Rock Cock.*

1st & Reserve Special Prize, No. 174.—RICHARD MAJOR, Kirkby Lonsdale.
2nd, No. 169.—E. MARSHALL, Gregory Street, Lenton, Nottingham.
3rd, No. 175.—E. W. ALLENBY, Three Oaks, Virginia Water.
4th, No. 172.—W. SLATER, Greenlot, Caton, Lancaster.

R.N. No. 176.—W. BORTHWICK, The Old Rectory, Hatfield.
H.C. No. 170.

Class 444.—*Barred Plymouth Rock Hen.*

1st & Plymouth Rock Society's Silver Spoon, No. 183, & 3rd, No. 181.—W. BORTHWICK, The Old Rectory, Hatfield.
2nd, No. 178.—E. MARSHALL, Gregory Street, Lenton, Nottingham.
4th, No. 180.—E. W. ALLENBY, Three Oaks, Virginia Water.

H.C. No. 179. C. No. 182.

Class 445.—*Barred Plymouth Rock Cockerel.*

1st, No. 184.—W. BORTHWICK, The Old Rectory, Hatfield.
2nd, No. 187.—RICHARD MAJOR, Kirkby Lonsdale.
3rd, No. 185.—T. GARLICK, Crag Bank Lane, Carnforth.
4th, No. 189.—PENPRASE BROS., Redruth, Cornwall.

R.N. No. 188.—E. W. ALLENBY, Three Oaks, Virginia Water.

Class 446.—*Barred Plymouth Rock Pullet.*

1st, No. 192.—E. W. ALLENBY, Three Oaks, Virginia Water.
2nd, No. 190.—PENPRASE BROS., Redruth, Cornwall.

Class 447.—*Buff Plymouth Rock Cock or Cockerel.*

1st & Plymouth Rock Society's Silver Spoon, No. 196.—H. T. STONEX, Burlands, Taunton.
2nd, No. 197.—W. BORTHWICK, The Old Rectory, Hatfield.
3rd, No. 195.—HOWARD PAGE, The Cedars, Gt. Horkesley, Colchester.

Class 450.—*Plymouth Rock Any Other Colour Hen or Pullet.*

1st & Plymouth Rock Society's Silver Spoon, No. 200.—E. W. ALLENBY, Three Oaks, Virginia Water. (Black.)
2nd, No. 199.—R. ANTHONY, Euxton, Chorley, Lancs. (White.)

Class 451.—*Old English Game Black-Red Cock or Cockerel.*

1st, No. 204.—JOSEPH JONES, 4, Cynon Row, Trecynon, Aberdare.
2nd, No. 206.—GREENHOW & HARTLEY, Galaberry P.F., Annan.
3rd, No. 208, & R.N., No. 205.—A. SLATER, The Old Vicarage, Lythe, Whitby.
4th, No. 202.—WILSON BUTLER, Glebelands, Broughton-in-Furness.

H.C. 203.

Class 452.—*Old English Game Clay or Wheaten Hen or Pullet.*

1st, No. 212.—GREENHOW & HARTLEY, Galaberry P.F., Annan.
2nd, No. 211.—J. H. BAKER & SON, Windyash, Barnstaple.
3rd, No. 209.—WILSON BUTLER, Glebelands, Broughton-in-Furness.
4th, No. 213, & R.N., No. 210.—CAPT. C. W. WILSON, Kirkland, Wigton.

Class 453.—*Old English Game Any Other Colour Cock or Cockerel.*

1st, No. 222.—H. WHITLEY, Primley, Paignton.
2nd. No. 215.—CAPT. C. W. WILSON, Kirkland, Wigton.
3rd, No. 217.—A. J. MAJOR, Ditton, Langley, Bucks.
4th, No. 225.—HARRY FOX, International Poultry Yards, Matlock.

R.N. No. 227.—J. H. BAKER & SON, Windyash, Barnstaple.
H.C. No. 229. C. No. 216.

Class 454.—*Old English Game Any Other Colour Hen or Pullet.*

1st, No. 236.—E. P. Hughes, Crumpwell, Oswestry.
2nd, No. 231, & 3rd, No. 243.—E. Stanley Webb, Pontvaen, Hay, Herefordshire.
4th, No. 232.—Capt. C. W. Wilson, Kirkland, Wigton.

R.N. No. 239.—J. H. Baker & Son, Windyash, Barnstaple.
H.C. No. 234. C. No. 240.

Class 455.—*Indian Game Cock or Cockerel.*

1st, No. 247.—J. H. Baker & Son, Windyash, Barnstaple.
2nd, No. 249.—E. C. Tucker, The Laynes, Churchdown, Gloucester.
3rd, No. 248.—W. W. Whiteman, Abbots Lodge, Sandhurst, Gloucester.
4th, No. 245.—W. E. Platten, Hill Farm, Little Ryburgh, Fakenham.

R.N. No. 246.—H. Whitley, Primley, Paignton.
H.C. No. 244.

Class 456.—*Indian Game Hen or Pullet.*

1st, No. 251, & 3rd, No. 253.—J. H. Baker & Son, Windyash, Barnstaple.
2nd, No. 250.—W. E. Platten, Hill Farm, Little Ryburgh, Fakenham.

Class 457.—*Faverolles Cock or Cockerel.*

1st, No. 258.—G. Tomkin, Marden, Kent.
2nd, No. 254.—A. B. Memmory, Littleover Prize Farm, Derby.
3rd, No. 260.—W. Borthwick, The Old Rectory, Hatfield.
4th, No. 259.—C. H. Bradley, Tibberton, Gloucester.

R.N. No. 257.—Dr. T. W. E. Royden, Fleggburgh, Norfolk.
H.C. No. 256.

Class 458.—*Faverolles Hen or Pullet.*

1st, No. 268.—Mrs. M. J. Carter, Puckpool Farm, Arlingham, Glos.
2nd, No. 270, & 4th, No. 267.—A. B. Memmory, Littleover Prize Farm, Derby.
3rd, No. 265.—L. H. Voaden & Son, Hazel Brow, Okehampton.

R.N. No. 266.—W. Borthwick, The Old Rectory, Hatfield.
H.C. No. 264. C. No. 269.

Class 459.—*Minorca Cock or Cockerel.*

1st, No. 271, & 3rd, No. 275.—W. Binnie & Son, Garth House, Denny, Stirlingshire.
2nd, No. 274.—R. Davey, 54, West Street, Bridgwater.
4th, No. 273.—Frank C. Tozer, 4, Broadway Road, Kingsteignton, Newton Abbot.

R.N. No. 272.—Frank Norman, 17, Devon Place, Grangetown, Cardiff.

Class 460.—*Minorca Hen or Pullet.*

1st, No. 276.—W. Binnie & Son, Garth House, Denny, Stirlingshire.
2nd, No. 278.—T. Seddon, 233, Oldbury Road, Smethwick.
3rd, No. 279.—S. E. Parker, 466, Bloxwich Road, Ledmore, Walsall.
4th, No. 277.—Frank Norman, 17, Devon Place, Grangetown, Cardiff.

R.N. No. 280.—E. R. Pease, Croft House, Croft-on-Tees.

Class 461.—*Leghorn Cock or Cockerel.*

1st, No. 282.—R. Anthony, Euxton, Chorley, Lancs.
2nd, No. 283.—W. Binnie & Son, Garth House, Denny, Stirlingshire.
3rd, No. 284.—J. Livingstone, Peel Hill, Strathaven.

Class 462.—*Leghorn Hen or Pullet.*

1st, No. 285.—W. Binnie & Son, Garth House, Denny, Stirlingshire.
2nd, No. 287.—H. Spencer, Leghorn Yard, Melksham.
3rd, No. 288.—R. Anthony, Euxton, Chorley, Lancs.
4th, No. 286.—W. H. Leeson, 91, Harnall Lane East, Coventry.

R.N. No. 289.—J. C. Ross, Stirling Road, Larbert.

Class 463.—*Ancona Cock or Cockerel.*

1st, No. 290.—Edward Bebb, Hadleigh, Suffolk.
2nd, No. 291.—E. A Stephens, Place, Portscatho, Cornwall.
3rd, No. 294.—J. H. Baker & Son, Windyash, Barnstaple.
4th, No. 292.—R. Anthony, Euxton, Chorley, Lancs.

R.N. No. 295.—A. Southern, 86, Burnley Road, Padiham.
H.C. No. 293.

Class 464.—*Ancona Hen or Pullet.*

1st, No. 296.—R. ANTHONY, Euxton, Chorley, Lancs.
2nd, No. 298, & 4th, No. 300.—A. SOUTHERIN, 88, Burnley Road, Padiham.
3rd, No. 297.—E. HOLT, The Limes, Pulford, Wrexham.

R.N. No. 299.—W. BORTHWICK, The Old Rectory, Hatfield.

Class 465.—*White Silkie Cock or Cockerel.*

1st & Silkie Club's Special Prize, No. 301.—MRS. FENTIMAN, Haldon, 186, Whitworth Road, Swindon.
2nd, No. 304.—MRS. A. M. HALL, The Gables, Ruyton-XI-Towns.
3rd, No. 303.—H. HOUGH-WATSON, Braystones House, Beckermet.
4th, No. 305, & R.N., No. 302.—R. L. FAIRLEY, Lahana, Barnton, Midlothian.

Class 466.—*White Silkie Hen or Pullet.*

1st & Reserve for Special Prize, No. 311, & R.N., No. 307.—R. L. FAIRLEY, Lahana, Barnton, Midlothian.
2nd, No. 309.—H. HOUGH-WATSON, Braystones House, Beckermet.
3rd, No. 306.—MRS. FENTIMAN, Haldon, 186, Whitworth Road, Swindon.
4th, No. 308.—SIR HARRY HAGUE, Ovaltine Poultry Farm, Kings Langley.

H.C. No. 310.

Class 468.—*Silkie Any Other Colour Hen or Pullet.*

1st & Silkie Club's Special Prize, No. 315 (Blue), 2nd & Reserve for Special Prize, No.312 (Black).—DAVID DRAPER, 99, Boundary Road, St. John's Wood, London, N.W.
3rd, No. 314.—MRS. A. M. HALL, The Gables, Ruyton-XI-Towns. (Blue.)
4th, No. 313.—MRS. FENTIMAN, Haldon, 186, Whitworth Road, Swindon. (Gold.)

Class 469.—*Any Other Distinct Variety Cock.*

1st, No. 321.—H. HOUGH-WATSON Braystones House, Beckermet. (Buff Polish.)
2nd, No. 327.—J. PICKERILL, Moorside, Madeley, Crewe. (Langshan.)
3rd, No. 325.—R. ANTHONY, Euxton, Chorley, Lancs. (Hamburgh.)
4th, No. 318.—W. W. WHITEMAN, Abbots Lodge, Sandhurst, Gloucester. (Jubilee Indian Game.)

R.N. No. 323.—PATRICK BLOOMER, Nutfield Court, Nutfield, Surrey. (Sumatra Game.)
H.C. No. 328. C. No. 317.

Class 470.—*Any Other Distinct Variety Hen.*

1st, No. 337.—R. ANTHONY, Euxton, Chorley, Lancs. (Langshan.)
2nd, No. 338.—H. FORTUNE, Banklands, Silsden, Keighley. (Hamburgh.)
3rd, No. 341.—W. BORTHWICK, The Old Rectory, Hatfield. (Jersey Giant.)
4th, No. 335.—JAMES FOX, Undercliff, Bakewell. (Redcap.)

R.N. No. 336.—H. HOUGH-WATSON, Braystones House, Beckermet. (Buff Polish.)
H.C. No. 332. C. No. 340.

Class 472.—*Any Other Distinct Variety Pullet.*

1st, No. 346.—H. FORTUNE, Banklands, Silsden, Keighley. (Hamburgh.)
2nd, No. 344.—H. HOUGH-WATSON, Braystones House, Beckermet. (White Crested Black Polish.)
3rd, No. 345.—HARRY FOX, International Poultry Yards, Matlock. (Redcap.)
4th, No. 347.—J. PICKERILL, Moorside, Madeley, Crewe. (Langshan.)
R.N. No. 343.—MAJOR G. T. WILLIAMS, Tredrea, Perranwell. (Frizzle.)

Class 473.—*Utility Sussex Cock or Cockerel.*

1st, No. 355.—MRS. A. E. JENKINS, Wherwell P.F., Longparish, Andover.
2nd, No. 351.—FRENCH & MEIKLE, 3, Birchwood, Wilmington, Dartford.
3rd, No. 349.—COL. D. A. CHAYTOR, Pooley Hall, Polesworth, Tamworth.
4th, No. 348.—THE EARL OF BRADFORD, Weston Park, Shifnal.

R.N. No. 354.—E. HOLT, The Limes, Pulford, Wrexham.
H.C. Nos. 356, 358. C. No. 357.

Class 474.—*Utility Sussex Hen or Pullet.*

1st, No. 366, 4th, No. 361.—FRENCH & MEIKLE, 3, Birchwood, Wilmington, Dartford.
2nd, No. 359.—THE EARL OF BRADFORD, Weston Park, Shifnal.
3rd, No. 371.—W. BORTHWICK, The Old Rectory, Hatfield.

R.N. No. 362.—LORD KEMSLEY, Farnham Park P.F., Farnham Royal, Bucks.
H.C. Nos. 365, 370. C. 360.

Class 475.—*Utility Rhode Island Red Cock or Cockerel.*

1st & Rhode Island Red Club's Special Prize, No. 378.—JOHN KAY, Alderwood, Edenfield, Manchester
2nd, No. 373.—LORD GREENWAY, Stanbridge Earls P.F., Edenbridge.
3rd, No. 389.—W. BORTHWICK, The Old Rectory, Hatfield.
4th, No. 387.—F. MACHIN, New Pool Villa, Knypersly, Biddulph, Stoke-on-Trent.

R.N. No. 383.—RICHARD MOORE, The Orchards, Long Sutton, Wisbech.
H.C. Nos. 385, 388, 390. **C.** Nos. 376, 377, 379.

Class 476.—*Utility Rhode Island Red Hen or Pullet.*

1st & Reserve for Special Prize, No. 392.—LORD GREENWAY, Stanbridge Earls P.F., Edenbridge.
2nd, No. 395.—JOHN KAY, Alderwood, Edenfield, Manchester.
3rd, No. 397.—RICHARD MOORE, The Orchards, Long Sutton, Wisbech.
4th, No. 399, & R.N., No. 401.—J. H. EDWARDS, Staplegrove House, P.F., Staplegrove, Taunton.

H.C. No. 393.

Class 477.—*Utility White Leghorn Cock or Cockerel.*

1st, No. 402.—W. BINNIE & SON, Garth House, Denny, Stirlingshire.
2nd, No. 405.—R. ANTHONY, Euxton, Chorley, Lancs.
3rd, No. 407.—G. O. GARDNER, Greta Bank, Graveley, Hitchin.
4th, No. 403.—SIR HARRY HAGUE, Ovaltine Poultry Farm, Kings Langley.

R.N. No. 404.—H. K. MICHAEL & SON, Eau Bank P.F., North Somercotes, Louth.
H.C. No. 406.

Class 478.—*Utility White Leghorn Hen or Pullet.*

1st, No. 412.—H. SPENCER, Leghorn Yard, Melksham.
2nd, No. 409.—W. BINNIE & SON, Garth House, Denny, Stirlingshire.
3rd, No. 416.—W. BORTHWICK, The Old Rectory, Hatfield.
4th, No. 410.—SIR HARRY HAGUE, Ovaltine Poultry Farm, Kings Langley.

R.N. No. 411.—H. K. MICHAEL & SON, Eau Bank P.F., North Somercotes, Louth.
H.C. Nos. 413, 415. **C.** No. 414.

Class 480.—*Utility Leghorn Any Other Colour Hen or Pullet.*

1st, No. 421.—S. W. HOPKINSON, Alton P.F., Old Tupton, Chesterfield. (Black.)
2nd, No. 418.—R. ANTHONY, Euxton, Chorley, Lancs.
3rd, No. 420.—J. H. BAKER & SON, Windyash, Barnstaple. (Black.)
4th, No. 417.—J. W. RICHARDSON, Eastfield P.F., Earsdon, Northumberland. (Black.)

R.N. No. 422.—E. R. PEASE, Croft House, Croft-on-Tees. (Black).
H.C. Nos. 419, 424. **C.** 423.

Class 481.—*Utility Welsummer Cock or Cockerel.*

1st & Welsummer Club's Special Prize and Visiting Cup, No. 430.—D. SHAKESHAFT, Matherne, Gravel Lane, Wilmslow.
2nd & Reserve Special Prize and Visiting Cup, No. 429, & R.N., No. 432.—J. PURDHAM, 47, Harold Street, Currock, Carlisle.
3rd, No. 426.—HARRY SNOWDEN, Tillotson's Farm, Cononley, Keighley.
4th, No. 428.—F. A. COLES, Kilmersdon, Bath.

H.C. Nos. 425, 427. **C.** No. 433.

Class 482.—*Utility Welsummer Hen or Pullet.*

1st & Welsummer Club's Special Prize and Visiting Cup, No. 436.—F. A. COLES, Kilmersdon, Bath.
2nd & Reserve for Special Prize and Visiting Cup, No. 435.—HARRY SNOWDEN, Tillotson's Farm, Cononley, Keighley.
3rd, No. 438.—R. HARGREAVES, Abbeydene P.F., Whalley, Lancs.
4th, No. 437.—J. PURDHAM, 47, Harold Street, Currock, Carlisle.

R.N. No. 434.—W. D. POTTER, Farmhouse, East Drive, Napsbury, St. Albans.

Class 483.—*Utility Australorp Cock or Cockerel.*

1st, No. 440.—JOHN KAY, Alderwood, Edenfield, Manchester.
2nd, No. 441.—J. E. H. & MISS VENNING, Trefrank, St. Clether, Launceston.
3rd, No. 439.—T. B. CLARKSON, Bonds P.F., Pilling, Preston.
4th, No. 442.—T. H. EGGLESTONE, St. John's Chapel, Weardale, Co. Durham.

Class 484.—*Utility Australorp Hen or Pullet.*

1st, No. 447.—J. E. H. & MISS VENNING, Trefrank, St. Clether, Launceston.
2nd, No. 446.—J. W. SPARROW, Fir Tree Cottage, Gt. Bromley, Ardleigh, Essex.
3rd, No. 445.—JOHN KAY, Alderwood, Edenfield, Manchester.
4th, No. 443.—T. B. CLARKSON, Bond's P.F., Pilling, Preston.

R.N. No. 444.—E. DEARNLEY, Knott Hill, Delph, Oldham.

Class 485.—*Utility White Wyandotte Cock or Cockerel.*

1st, No. 451.—W. BORTHWICK, The Old Rectory, Hatfield.
2nd, No. 448.—W. BINNIE & SON, Garth House, Denny, Stirlingshire.
3rd, No. 450.—R. ANTHONY, Euxton, Chorley, Lancs.
4th, No. 449.—J. WHARTON, Honeycott Farm, Hawes, Yorkshire.

R.N. No. 452.—CHARLES MORGAN, Rectory View, Portskewett, Chepstow.

Class 486.—*Utility White Wyandotte Hen or Pullet.*

1st, No. 453.—W. BINNIE & SON, Garth House, Denny, Stirlingshire.
2nd, No. 458.—R. ANTHONY, Euxton, Chorley, Lancs.
3rd, No. 460.—W. BORTHWICK, The Old Rectory, Hatfield.
4th, No. 455.—A. E. GOULD, The Croft P.F., Coven, Wolverhampton.

R.N. No. 456.—J. WHARTON, Honeycott Farm, Hawes, Yorkshire.
H.C. No. 459.

Class 489.—*Utility Light Cock or Cockerel, any other variety.*

1st, No. 461.—W. BINNIE & SON, Garth House, Denny, Stirlingshire. (Minorca.)
2nd, No. 463.—R. ANTHONY, Euxton, Chorley, Lancs.
3rd, No. 464.—E. HOLT, The Limes, Pulford, Wrexham.
4th, No. 462.—HON. E. FITZHERBERT, Swynnerton Park, Stone. (Houdan.)

Class 490.—*Utility Light Hen or Pullet, any other variety.*

1st, No. 466.—W. BINNIE & SON, Garth House, Denny, Stirlingshire. (Minorca.)
2nd, No. 471.—H. FORTUNE, Banklands, Silsden, Keighley. (Hamburgh.)
3rd, No. 474.—J. H. BAKER & SON, Windyash, Barnstaple. (Ancona.)
4th, No. 470.—R. ANTHONY, Euxton, Chorley, Lancs.

R.N. No. 472.—E. HOLT, The Limes, Pulford, Wrexham.
H.C. Nos. 468, 469.

Class 491.—*Utility Heavy Cock or Cockerel, any other variety.*

1st, No. 479.—R. ANTHONY, Euxton, Chorley, Lancs.
2nd, No. 476.—W. J. GOLDING, Bowens, Penshurst, Kent. (Buff Orpington.)
3rd, No. 477.—A. J. MAJOR, Ditton, Langley, Bucks. (Silver Grey Dorking.)
4th, No. 482.—W. BORTHWICK, The Old Rectory, Hatfield. (Barred Rock.)

R.N. No. 480.—T. TRIGG, The Oaks, Anthill, Denmead, Cosham. (White Orpington.)
H.C. No. 478. C. No. 481.

Class 492.—*Utility Heavy Hen or Pullet, any other variety.*

1st, No. 489.—J. WHARTON, Honeycott Farm, Hawes, Yorkshire. (Partridge.)
2nd, No. 484.—W. J. GOLDING, Bowens, Penshurst, Kent. (Buff Orpington.)
3rd, No. 483.—W. BINNIE & SON, Garth House, Denny, Stirlingshire. (Barnevelder.)
4th, No. 485.—W. G. VIVIAN & SON, 5, Stanhope Square, Holsworthy, Devon. (Jersey Giant.)

R.N. No. 487.—A. J. MAJOR, Ditton, Langley, Bucks. (Silver Grey Dorking.)
H.C. No. 488. C. No. 491.

Class 493.—*Utility Light Hen, that has secured National Poultry Council Copper Ring.*

1st, No. 495 (White Leghorn), 2nd, No. 497 (Black Leghorn).—W. HAMNETT, Myrtle P.F., Breck Road, Poulton-le-Fylde.
3rd, No. 496.—W. BINNIE & SON, Garth House, Denny, Stirlingshire. (Leghorn.)

Class 494.—*Utility Heavy Hen, that has secured the National Poultry Council Copper Ring.*

1st, No. 504 (Light Sussex), 2nd, No. 501 (White Wyandotte), & 3rd, No. 503 (Rhode Island Red).—W. HAMNETT, Myrtle P.F., Breck Road, Poulton-le-Fylde.
4th, No. 499.—H. T. STONEX, Burlands, Taunton. (Buff Rock.)

R.N. No. 502.—RICHARD MOORE, The Orchards, Long Sutton, Wisbech. (White Wyandotte.)
H.C. No. 500.

Class 495.—*Wyandotte Bantam Cock or Cockerel.*

1st, No. 506.—J. Johnson, Moss Lane, Lathom, Ormskirk.
2nd, No. 508.—J. F. Entwisle, Crigglestone Manor, Wakefield.
3rd, No. 507.—W. Harper, Melrose, Garndiffaith, Pontypool.
4th, No. 505.—W. Binnie & Son, Garth House, Denny, Stirlingshire.

Class 497.—*Rhode Island Red Bantam Cock or Cockerel.*

1st & Reserve Special Prize, No. 513.—F. Machin, New Pool Villa, Knypersly, Biddulph, Stoke-on-Trent.
2nd, No. 511.—J. G. Williamson, Chester Road, Middlewich.
3rd, No. 514.—J. T. Wright, Prospect House, Hemingbrough, Selby.
4th, No. 512.—J. F. Entwistle, Crigglestone Manor, Wakefield.

R.N. No. 509.—Frank H. Page, Woodlands, Gt. Horkesley, Colchester.

Class 498.—*Rhode Island Red Bantam Hen or Pullet.*

1st & Rhode Island Red Club's Special Prize, No. 518.—John Kay, Alderwood, Edenfield, Manchester.
2nd, No. 521.—F. Machin, New Pool Villa, Knypersly, Biddulph, Stoke-on-Trent.
3rd, No. 522.—J. T. Wright, Prospect House, Hemingbrough, Selby.
4th, No. 519.—Harry Fox, International Poultry Yards, Matlock.

R.N. No. 520.—J. F. Entwistle, Crigglestone Manor, Wakefield.
H.C. No. 515. C. No. 517.

Class 501.—*Spangled Old English Game Bantam Cock or Cockerel.*

1st, No. 524.—R. Anthony, Euxton, Chorley, Lancs.
2nd, No. 526.—Greenhow & Hartley, Galaberry P.F., Annan.
3rd, No. 525.—W. Harper, Melrose, Garndiffaith, Pontypool.
4th, No. 523.—H. Whitley, Primley, Paignton.

Class 502.—*Spangled Old English Game Bantam Hen or Pullet.*

1st, No. 528.—R. Anthony, Euxton, Chorley, Lancs.
2nd, No. 532.—Greenhow & Hartley, Galaberry P.F., Annan.
3rd, No. 529.—W. Harper, Melrose, Garndiffaith, Pontypool.
4th, No. 530.—J. F. Entwisle, Crigglestone Manor, Wakefield.

R.N. No. 527.—H. Whitley, Primley, Paignton.

Class 503.—*Old English Game, any other colour, Bantam Cock or Cockerel.*

1st, No. 533, & 2nd, No. 539.—Richard J. West, Old Bracknell Cottage, Bracknell, Berks.
3rd, No. 534.—H. Whitley, Primley, Paignton.
4th, No. 538.—Greenhow & Hartley, Galaberry P.F., Annan.

R.N. No. 535.—J. H. Baker & Son, Windyash, Barnstaple.
H.C. No. 536. C. No. 537.

Class 504.—*Old English Game, any other colour, Bantam Hen or Pullet.*

1st, No. 545.—J. H. Baker & Son, Windyash, Barnstaple.
2nd, No. 549.—Greenhow & Hartley, Galaberry P.F., Annan.
3rd, No. 543.—Harry Fox, International Poultry Yards, Matlock.
4th, No. 540.—Joseph Jones, 4, Cynon Row, Trecynon, Aberdare.

R.N. No. 546.—Richard J. West, Old Bracknell Cottage, Bracknell, Berks.
H.C. No. 541. C. No. 548.

Class 505.—*Sebright Bantam Cock or Cockerel.*

1st, No. 552, & 2nd, No. 554.—R. Anthony, Euxton, Chorley, Lancs.
3rd, No. 551.—T. H. Sheldon, Cotham Manor, Newark.
4th, No. 550.—G. A. Drake, 37, North Street, Braunton.

R.N. No. 553.—J. F. Entwisle, Crigglestone Manor, Wakefield.

Class 506.—*Sebright Bantam Hen or Pullet.*

1st, No. 557, & 2nd, No. 560.—R. Anthony, Euxton, Chorley, Lancs.
3rd, No. 558.—J. F. Entwisle, Crigglestone Manor, Wakefield.
4th, No. 559, & R.N., No. 556.—T. H. Sheldon, Cotham Manor, Newark.
H.C. No. 561. C. No. 555.

Class 507.—*Bantam Cock or Cockerel, any other variety.*

1st, No. 571.—J. F. ENTWISLE, Crigglestone Manor, Wakefield. (Indian Game.)
2nd, No. 569.—H. HOUGH-WATSON, Braystones House, Beckermet. (Pekin.)
3rd, No. 562.—W. BINNIE & SON, Garth House, Denny, Stirlingshire. (Minorca.)
4th, No. 573.—E. W. ALLENBY, Three Oaks, Virginia Water. (Belgian d'Anvers.)

R.N. No. 567.—MAJOR G. T. WILLIAMS, Tredrea, Perranwell. (Frizzle.)
H.C. No. 570. C. No. 572.

Class 508.—*Bantam Hen or Pullet, any other variety.*

1st, No. 577.—H. HOUGH-WATSON, Braystones House, Beckermet. (White Polish.)
2nd, No. 582.—R. ANTHONY, Euxton, Chorley, Lancs.
3rd, No. 584.—J. H. BAKER & SON, Windyash, Barnstaple.
4th, No. 574 (Japanese), R.N., No. 579 (Frizzle).—MAJOR G. T. WILLIAMS, Tredrea, Perranwell.

H.C. No. 576. C. No. 581.

Class 511.—*Indian Runner Drake or Duck, bred prior to* 1937.

1st, No. 590.—REV. J. HEWETSON, Burbage Vicarage, Buxton.
2nd, No. 594, & 3rd, No. 588.—CAPT. C. O'S. CREE, Ower Moigne, Dorchester.
4th, No. 591.—H. HOUGH-WATSON, Braystones House, Beckermet.

R.N. No. 592.—F. ARGO, Bructor, Inverurie.
H.C. No. 589. C. No. 597.

Class 512.—*Indian Runner Drake or Duck, bred in* 1937.

1st, No. 599.—R. ANTHONY, Euxton, Chorley, Lancs.
2nd, No. 601, & 4th, No. 598.—CAPT. C. O'S. CREE, Ower Moigne, Dorchester.
3rd, No. 600.—G. V. JACKSON, JUNR., The Mansion, Ford, Shrewsbury.

Class 513.—*Drake, any other variety.*

1st, No. 606.—ABBOT BROS., Thuxton, Norfolk.
2nd, No. 603.—MAJOR L. C. CHAWNER, Little Barrs, New Milton, Hants. (Cayuga.)
3rd, No. 605.—R. ANTHONY, Euxton, Chorley, Lancs.
4th, No. 604.—A. J. MAJOR, Ditton, Langley, Bucks. (Muscovy.)

Class 514.—*Duck, any other variety.*

1st, No. 609.—REV. J. HEWETSON, Burbage Vicarage, Buxton. (Rouen.)
2nd, No. 608.—MAJOR L. C. CHAWNER, Little Barrs, New Milton, Hants. (Cayuga.)
3rd, No. 611, & 4th, No. 613.—R. ANTHONY, Euxton, Chorley, Lancs. (Muscovy.)
R.N. No. 610.—A. J. MAJOR, Ditton, Langley, Bucks.

Class 517.—*Turkey Cock.*

1st, No. 618.—MRS. A. E. JENKINS, Wherwell P.F., Longparish, Andover.
2nd, No. 620.—J. MCCORMICK, Crosshill, Crumlin, Co. Antrim.
3rd, No. 615.—H. T. STONEX, Burlands, Taunton.
4th, No. 616.—H. WHITLEY, Primley, Paignton.

R.N. No. 619.—MRS. L. DAWS, Heath Farm, Weeley Heath, Clacton-on-Sea.
H.C No. 621. C. No. 614.

Class 518.—*Turkey Hen.*

1st, No. 625.—ABBOT BROS., Thuxton, Norfolk.
2nd, No. 624.—E. P. WOOLLATT, Duntons Farm, Lavenham, Suffolk.
3rd, No. 623, & 4th, No. 626.—F. E. PEELE, Thuxton, Norfolk.

EGGS.

Unless otherwise stated the Prizes for Eggs are as follows: First Prize, 20s.; Second Prize, 15s.; Third Prize, 10s; Fourth Prize, 5s.

Class 519.—*Twelve Hens' Eggs—Brown.*

1st, No. 8, & 2nd, No. 11.—MISS P. PEER, Rectory Farm, Tibberton, Droitwich.
3rd, No. 6.—MISS CHARLOTTE FAWKES, Fern Bank Farm, Balsall Common, Coventry.
4th, No. 10.—R. J. WOOLF, Chebsey, Stafford.

R.N. No. 3.—JAMES W. HIRD, Coppy House, Clapham, Lancaster.
H.C. No. 2.

Class 520.—*Twelve Hens' Eggs—White or Cream.*

1st, No. 18, & 2nd, No. 15.—J. W. RICHARDSON, Eastfield Poultry Farm, Earsdon, Northumberland. (White.)
3rd, No. 12.—VICTOR BIRTWISTLE, 2, Carr Head, Trawden Forest, Colne. (White.)

Class 521.—*Twelve Hens' Eggs—Tinted.*

1st, No. 22.—MISS P. PEER, Rectory Farm, Tibberton, Droitwich.
2nd, No. 19.—MRS. DREDGE, Barton Farm, Holwell, Sherborne, Dorset.

Class 522.—*Twelve Ducks' Eggs.*

1st, No. 27.—W. H. STEVENS, Brookfield, Sports Road, Glenfields, Leicester.
2nd, No. 28.—STUDLEY COLLEGE, Studley, Warwickshire.
3rd, No. 25.—MRS. DREDGE, Barton Farm, Holwell, Sherborne, Dorset.

Class 523.—*One Pack of 15 dozen Eggs, Statutory Special Grade, the produce of a Producer-owned Packing Station.*

1st, 50s. No. 34.—SOMERSET POULTRY MARKETING ASSOCIATION, LTD., Eastfields Farm, Edington, Bridgwater.
2nd, 40s. No. 29.—BANBURY EGG PRODUCERS, LTD., 63, George Street, Banbury.
3rd, 20s. No. 31.—FELIX MCBRAIDA, Windyridge, Hursley Hill, Whitchurch, Bristol.
4th, 10s. No. 30.—EAST ANGLIAN EGG PACKING STATION, LTD., Paddock Street, Soham, Ely, Cambs.
R.N. No. 33.—S.P.B.A. PACKING STATIONS (CENTRAL SALES), LTD., 68, Brewery Road, London, N.7.

Class 524.—*One Pack of 15 dozen Eggs, Statutory Standard Grade, the produce of a Producer-owned Packing Station.*

1st, 50s. No. 39.—SOMERSET POULTRY MARKETING ASSOCIATION, LTD., Eastfields Farm, Edington, Bridgwater.
2nd, 40s. No. 35.—BANBURY EGG PRODUCERS, LTD., 63, George Street, Banbury.
3rd, 20s. No. 38.—S.P.B.A. PACKING STATIONS (CENTRAL SALES), LTD., 68, Brewery Road, London, N.7.
4th, 10s. No. 36.—EAST ANGLIAN EGG PACKING STATION, LTD., Paddock Street Soham, Ely, Cambs.

FARM AND DAIRY PRODUCE OF THE UNITED KINGDOM.

Butter.

The Prizes for Butter are as follows: First Prize, £3; Second Prize, £2; Third Prize, £1.

Class 525.—*Two pounds of Fresh Butter, without any salt, made up in plain pounds, from the milk of Channel Island, Devon or South Devon Cattle and their crosses.*

1st, No. 41.—MRS. G. E. BLACKLER, West Leigh, Modbury, S. Devon.
2nd, No. 46.—MRS. JOHN WAY, West Bridge, Bishopsnympton, South Molton, Devon.
3rd, No. 42.—A. G. DENNIS, Lower Pulworthy, Highampton, Beaworthy, Devon.
R.N. No. 44.—MRS. J. MOGFORD, Overcott, Rose Ash, South Molton, Devon.
H.C. No. 45.

Class 526.—*Two pounds of Fresh Butter, without any salt, made up in plain pounds, from the milk of cattle of any breed or cross other than those mentioned in Class 525.*

1st, No. 48.—MRS. B. DENNIS, Pulworthy, Highampton, Beaworthy, Devon.
2nd, No. 52.—MRS. P. ROACH, Beersheba, Lelant, Cornwall.
3rd, No. 50.—MRS. M. C. INGE, Thorpe Hall, Tamworth.
R.N. No. 53.—MISS A. M. WARD, Foggathorpe Hall, Selby, Yorks.
H.C. No. 49.

Class 527.—*Two pounds of Fresh Butter, slightly salted, made up in plain pounds, from the milk of Channel Island, Devon or South Devon Cattle and their crosses.*

1st, & R.N. for Champion Prize. No. 58.—MRS. J. MOGFORD, Overcott, Rose Ash, South Molton, Devon.
2nd, No. 55.—MRS. G. E. BLACKLER, West Leigh, Modbury, S. Devon.
3rd, No. 61.—MRS. JOHN WAY, West Bridge, Bishopsnympton, South Molton, Devon.
R.N. No. 56.—A. G. DENNIS, Lower Pulworthy, Highampton, Beaworthy, Devon.
H.C. No. 60. C. No. 59.

Class 528.—*Two pounds of Fresh Butter, slightly salted, made up in plain pounds, from the milk of cattle of any breed or cross other than those mentioned in Class* 527.

1st, & Champion Prize of £5. No. 63.—MRS. B. DENNIS, Pulworthy, Highampton, Beaworthy, Devon.
2nd, No. 67.—MRS. P. ROACH, Beersheba, Lelant, Cornwall.
3rd, No. 66.—MIDLAND COUNTIES DAIRY, LTD., Corporation Street, Birmingham.
R.N. No. 68.—MISS A. M. WARD, Foggathorpe Hall, Selby, Yorks.

Class 529.—*Three pounds of Fresh Butter, slightly salted, made up in pounds in the most attractive marketable designs.*

1st, No. 72.—MRS. J. MOGFORD, Overcott, Rose Ash, South Molton, Devon.
2nd, No. 73.—J. PIERPONT MORGAN, Wall Hall. Aldenham, Watford.
3rd, No. 74.—MRS. HOWARD PALMER, Heathlands, Wokingham, Berks.
R.N. No. 75.—MRS. JOHN WAY, West Bridge, Bishopsnympton, South Molton, Devon.

Cheese.

Made in 1937.

Unless otherwise stated, the Prizes for Cheese are as follows: First Prize, £5; Second Prize, £3; Third Prize, £2; Fourth Prize, 10s.; Fifth Prize, 5s.

Class 530.—*Two Cheshire Cheeses (coloured), not less than* 40 *lb. each, made by a Farmer-Producer.*

1st, No. 82.—W. H. HOBSON, Woodhey Hall, Nantwich.
2nd, No. 78.—THOMAS E. BECKETT, Hall o'Coole, Nantwich.
3rd, No. 77.—J. C. BARNETT, The Hully, Tybroughton, Whitchurch, Shropshire.
4th, No. 91.—P. H. WALLEY, Towns Green Farm, Wettenhall, Winsford, Cheshire.
5th, No. 92.—THOMAS W. YOUNG, Sicilly Oak Farm, Cholmondley, Malpas.
R.N. No. 80.—J. T. FORTNAM, Rudge Farm, Ashley, Market Drayton.
H.C. Nos. 76, 84. C. Nos. 83, 89.

Class 531.—*Two Cheshire Cheeses (uncoloured), not less than* 40 *lb. each, made by a Farmer-Producer.*

1st, No. 99.—W. H. HOBSON, Woodhey Hall, Nantwich.
2nd, No. 105.—A. E. WALLEY, Bickerton Hall, Malpas, Cheshire.
3rd, No. 106.—P. H. WALLEY, Towns Green Farm, Wettenhall, Winsford, Cheshire.
4th, No. 107.—THOMAS W. YOUNG, Sicilly Oak Farm, Cholmondley, Malpas.
5th, No. 95.—THOMAS E. BECKETT, Hall o'Coole, Nantwich.
R.N. No. 97.—J. T. FORTNAM, Rudge Farm, Ashley, Market Drayton.
H.C. Nos. 93, 101. C. Nos. 94, 96.

Class 532.—*Two Cheshire Cheeses (coloured or uncoloured), not less than* 40 *lb. each, made by a Farmer-Producer who has not won a* 1*st,* 2*nd or* 3*rd Prize at the Royal Show for the last five years.*

1st, No. 109.—THOMAS E. BECKETT, Hall o'Coole, Nantwich.
2nd, No. 108.—J. C. BARNETT, The Hully, Tybroughton, Whitchurch, Shropshire.
3rd, No. 113.—ALAN NODEN, Aston Lower Hall, Worleston, Nantwich.
4th, No. 110.—J. T. FORTNAM, Rudge Farm, Ashley, Market Drayton.
R.N. No. 114.—WM. ROGERS, Arscott Hall, Pontesford, Shrewsbury.
H.C. No. 112. C. No. 111.

Class 533.—*Two Cheshire Cheeses (coloured), not less than* 40 *lb. each, restricted to Factory-made Cheese.*

1st, No. 118.—B. S. BOSTOCK, LTD., Mere Field Model Dairy, Haslington, Crewe.
2nd, No. 117.—ANN'S FARMHOUSE, LTD., Cropwell Bishop, Notts.

Class 534.—*Two Cheshire Cheeses (uncoloured), not less than* 40 *lb. each, restricted to Factory-made Cheese.*

1st, No. 119.—B. S. BOSTOCK, LTD., Mere Field Model Dairy, Haslington, Crewe.

Class 535.—*Two Cheddar Cheeses, not less than* 50 *lb. each.*

1st, No. 122.—B. H. J. W. WHITE, Hill View Farm, Bruton, Somerset.
2nd, No. 123.—SIDNEY T. WHITE, Sock Dennis Farm, Ilchester.
3rd, No. 120.—H. H. PICKFORD, Manor Farm, Patney, Devizes.
R.N. No. 121.—FRANK FORTCH, Leigh Farm, Wincanton, Somerset.

Class 536.—*Two Cheddar Cheeses, not more than 50 lb. each.*

1st, No. 128.—B. H. J. W. WHITE, Hill View Farm, Bruton, Somerset.
2nd, No. 129.—SIDNEY T. WHITE, Sock Dennis Farm, Ilchester.
3rd, No. 125.—CHEDDAR VALLEY DAIRY CO., LTD., Rooksbridge, Axbridge.

R.N. No. 127.—FRANK PORTCH, Leigh Farm, Wincanton, Somerset.

Class 537.—*Two Loaf or other Cheddar Truckles.*

1st, No. 132.—FRANK PORTCH, Leigh Farm, Wincanton, Somerset.
2nd, No. 134.—SIDNEY T. WHITE, Sock Dennis Farm, Ilchester.
3rd, No. 133.—B. H. J. W. WHITE, Hill View Farm, Bruton, Somerset.

R.N. No. 130.—ANN'S FARMHOUSE, LTD., Cropwell Bishop, Notts.

Class 538.—*Two Stilton Cheeses.*

1st, No. 137.—J. M. NUTTALL & CO., LTD., Dove Dairy, Hartington, Buxton.
2nd, No. 142.—TUXFORD & TEBBUTT, LTD., Thorpe End, Melton Mowbray.
3rd, No. 139.—WILTS UNITED DAIRIES, LTD., Harby, Melton Mowbray.
4th, No. 136.—LONG CLAWSON DAIRY, LTD., Hose, Melton Mowbray.

Class 539.—*Two Wensleydale Cheeses (Stilton Shape).*

1st, No. 146.—J. M. NUTTALL & CO., LTD., Dove Dairy, Hartington, Buxton.
2nd, No. 147.—ALFRED ROWNTREE & SONS, LTD., Coverham, Middleham, Yorks.
3rd, No. 145.—MISS B. J. MUDD, Aldborough Dairy, Boroughbridge, Yorks.

R.N. No. 144.—MISS RACHEL JAMES, Llancayo, Usk, Mon.

Class 540.—*Two Staffordshire or Derbyshire Cheeses.*

1st, No. 149.—CHEDDAR VALLEY DAIRY CO., LTD., Rooksbridge, Axbridge.
2nd, No. 148.—ANN'S FARMHOUSE, LTD., Cropwell Bishop, Notts.
3rd, No. 150.—J. M. NUTTALL & CO., LTD., Dove Dairy, Hartington, Buxton.

Class 541.—*Two Leicestershire Cheeses.*

1st, No. 151.—ANN'S FARMHOUSE, LTD., Cropwell Bishop, Notts.
2nd, No. 152.—W. H. R. GILBERT, The Cottage, Aston Flamville, Hinckley.
3rd, No. 156.—TUXFORD & TEBBUTT, LTD., Thorpe End, Melton Mowbray.

R.N. No. 155.—STEPHEN TRUELOVE, Gate Farm, Monks Kirby, Rugby.

Class 542.—*Two Caerphilly Cheeses.*

1st, No. 160.—MONMOUTHSHIRE INSTITUTE OF AGRICULTURE, Usk.
2nd, No. 157.—ANN'S FARMHOUSE, LTD., Cropwell Bishop, Notts.
3rd, No. 158.—CHEDDAR VALLEY DAIRY CO., LTD., Rooksbridge, Axbridge.

R.N. No. 159.—MISS RACHEL JAMES, Llancayo, Usk.

Class 543.—*Two Small Cheeses, not exceeding 6 lb. each, of Cheddar or Cheshire character.*

1st, £3. No. 171.—P. H. WALLEY, Towns Green Farm, Wettenhall, Winsford, Cheshire.
2nd, £2. No. 172.—B. H. J. W. WHITE, Hill View Farm, Bruton, Somerset.
3rd, £1. No. 162.—THOMAS E. BECKETT, Hall o'Coole, Nantwich.
4th, 10s. No. 164.—J. T. FORTNAM, Rudge Farm, Ashley, Market Drayton.
5th, 5s. No. 170.—A. E. WALLEY, Bickerton Hall, Malpas, Cheshire.

R.N. No. 168.—FRANK PORTCH, Leigh Farm, Wincanton, Somerset.
H.C. No. 169. C. No. 161.

Class 544.—*Two Small Cheeses, not exceeding 6 lb. each, of Stilton or Wensleydale character.*

1st, £3. No. 176.—J. M. NUTTALL & CO., LTD., Dove Dairy, Hartington, Buxton.
2nd, £2. No. 178.—TUXFORD & TEBBUTT, LTD., Thorpe End, Melton Mowbray.
3rd, £1. No. 174.—LONG CLAWSON DAIRY CO., LTD., Hose, Melton Mowbray.

R.N. No. 175.—MISS B. J. MUDD, Aldborough Dairy, Boroughbridge, Yorks.

Class 545.—*Two Soft Cheeses, made from whole milk.*

1st, £3. No. 180.—C. J. ALLDAY, Manor Farm, Fotheringhay, Peterborough.
2nd, £2. No. 185.—MONMOUTHSHIRE INSTITUTE OF AGRICULTURE, Usk.
3rd £1. No. 182.—MISS EMILY E. JAMES, Copt Heath Farm, Solihull.

R.N. No. 183.—MISS RACHEL JAMES, Llancayo, Usk.
H.C. No. 184.

Class 546.—*Two Cheeses, made from Cream without the addition of Rennet.*

1st, £3. No. 191.—Monmouthshire Institute of Agriculture, Usk.
2nd, £2. No. 190.—Miss Rachel James, Llancayo, Usk.
3rd, £1. No. 187.—Mrs. B. Crosby, Berry Green, Badby, Daventry.

R.N. No. 189.—Miss Emily E. James, Copt Heath Farm, Solihull.
H.C. No. 186.

Cider.

The Prizes for Cider are as follows: First Prize, £3; Second Prize, £2; Third Prize, £1; Fourth Prize, 10s.

Class 547.—*Casks of Cider, not less than 6 gallons, made in* 1936 *by an Exhibitor whose main occupation is Farming.*

1st, No. 195.—H. W. Davis, Sutton Montis, Yeovil.
2nd, No. 197.—S. J. Sheppy, Three Bridges, Taunton.

Class 548.—*Cask of Cider, not less than* 6 *gallons, made in* 1936.

1st, No. 206.—S. J. Sheppy, Three Bridges, Taunton.
2nd, No. 200.—H. W. Davis, Sutton Montis, Yeovil.

Class 549.—*Six Bottles of Cider, made in* 1936 *by an Exhibitor whose main occupation is Farming.*

1st, No. 211.—Harry E. R. Warren, Highfield Farm, Netherbury, Dorset.
2nd, No. 209.—H. H. Sealy & Son, Honeyhurst Farm, Rodney Stone, Cheddar, Somerset.
3rd, No. 210.—S. J. Sheppy, Three Bridges, Taunton.

Class 550.—*Six Bottles of Dry Cider, made in* 1936.

1st, No. 216.—Pullin Bros., Compton Greenfield, Bristol.
2nd, No. 222.—S. J. Sheppy, Three Bridges Farm, Taunton.
3rd, No. 215.—M. J. Pearce, Upton Farm, Strode, Winford, Bristol.

R.N. No. 221.—H. H. Sealy & Son, Honeyhurst Farm, Rodney Stone, Cheddar, Somerset.

Class 551.—*Six Bottles of Sweet Cider, made in* 1936.

1st, No. 227.—Pullin Bros., Compton Greenfield, Bristol.
2nd, No. 230, & 3rd, No. 229.—Quantock Vale Cider Co., Ltd., North Petherton, Bridgwater, Somerset.
4th, No. 223.—D. J. Crofts, Sutton Farm, Sutton Montis, Yeovil.

R.N. No. 231.—Ridler & Son, Ltd., Clehonger, Hereford.
H.C. No. 232.

Class 552.—*Six Bottles of Cider, made previous to* 1936.

1st, No. 238.—Gloucestershire Cider Co., Ltd., Wickwar, Glos.
2nd, No. 241.—Quantock Vale Cider Co., Ltd., North Petherton, Bridgwater, Somerset.
3rd, No. 243.—H. H. Sealy & Son, Honeyhurst Farm, Rodney Stone, Cheddar, Somerset.

R.N. No. 242.—Ridler & Son, Ltd., Clehonger, Hereford.

Class 553.—*Six Bottles of Cider, bearing the National Mark, made in* 1936.

1st, No. 248.—Pullin Bros., Compton Greenfield, Bristol.
2nd, No. 254.—S. J. Sheppy, Three Bridges, Taunton.
3rd, No. 255.—Harry E. R. Warren, Highfield Farm, Netherbury, Dorset.

Wool.

Of 1937 clip.

First Prize, £3; Second Prize, £2; Third Prize, £1.

Class 554.—*Three Fleeces of Oxford Down.*

1st, No. 260, & 2nd, No. 259.—T. W. Montague Perkins, Ufton Court, Holme Lacy, Hereford.
3rd, No. 262.—Hugh William Stilgoe, The Grounds, Adderbury, Banbury.

Class 555.—*Three Fleeces of Shropshire.*

1st, & R.N. for "Merchants of the Staple of England" Special Prize, No. 267.—Mrs. M. C. Inge, Thorpe Hall, Tamworth.
2nd, No. 265, & 3rd, No. 264.—A. E. Everall, Sherlowe, Wellington, Shropshire.

Class 556.—*Three Fleeces of Southdown.*

1st, No. 278.—JOE K. WILLIAMSON, Derwen Hall, Ruthin.
2nd, No. 268, & 3rd, No. 269.—HIS MAJESTY THE KING, Sandringham.
4th, 10s. No. 276.—HERBERT D. SHIELDS, Borderlands, Culford, Suffolk.

Class 557.—*Three Fleeces of Hampshire Down.*

1st, No. 282, & 2nd, No. 281.—WILLIAM TODD, Little Ponton Grange, Grantham.
3rd, No. 280.—E. CLIFTON-BROWN, Burnham Grove, Burnham, Bucks.

Class 558.—*Three Fleeces of Suffolk.*

1st & "Merchants of the Staple of England" Special Prize, No. 283.—SIR PRINCE PRINCE-SMITH, BT., Southburn, Driffield.

Class 559.—*Three Fleeces of Dorset Down.*

1st, No. 286, & 2nd, No. 285.—LEONARD TORY, Turnworth, Blandford.
3rd, No. 284.—THE EARL OF ELGIN, K.T., C.M.G., Broomhall, Dunfermline.

Class 560.—*Three Fleeces of Dorset Horn.*

1st, No. 290, & 2nd, No. 291.—ALFRED READ, Lower Farm, Hilton, Blandford.
3rd, No. 289.—CHARLES JOCELYN HAMBRO, Hedge End Farm, Blandford.

Class 561.—*Three Fleeces of Ryeland.*

1st, No. 293, & 3rd, No. 292.—T. W. MONTAGUE PERKINS, Ufton Court, Holme Lacy, Hereford.
2nd, No. 295.—DAVID J. THOMAS, Monachty, Abergavenny.

Class 562.—*Three Fleeces of Kerry Hill (Wales).*

1st, No. 297, & 2nd, No. 298.—JOHN T. BEAVAN, Winsbury, Chirbury, Montgomery.

Class 563.—*Three Fleeces of Clun Forest.*

1st, No. 300.—R. F. MITCHELL EVANS, Cholstrey Court, Leominster.
2nd, No. 299.—A. DAVIES, Fields End, Weobley, Hereford.
3rd, No. 301.—T. E. GWILLIM, Ffostill, Talgarth, Brecon.

Class 564.—*Three Fleeces of Lincoln.*

1st & "Merchants of the Staple of England" Special Prize, No. 304.—CLIFFORD NICHOLSON, Willoughton Manor, Lincoln.
2nd, No. 303, & 3rd, No. 302.—D. F. BROWETT, Thornton House, Thornton, Horncastle.

Class 565.—*Three Fleeces of Border Leicester.*

[NO ENTRY.]

Class 566.—*Three Fleeces of Wensleydale.*

1st, No. 305.—T. B. EARLE, Bolton Grange, Scorton, Richmond, Yorks.
2nd, No. 308.—J. B. SMALLEY, Birkby Hall, Cark-in-Cartmel.
3rd, No. 306.—J. PERCIVAL, Easthouse, Carperby, Yorks.

Class 567.—*Three Fleeces of Kent or Romney Marsh, Rams of any age.*

1st, No. 310.—L. H. FINN, The Mall, Faversham, Kent.
2nd, No. 312.—ASHLEY STEVENS, Davington Hall, Faversham, Kent.
3rd, No. 309.—E. W. BAKER, Parsonage Farm, Bekesbourne, Canterbury.

Class 568.—*Three Fleeces of Kent or Romney Marsh, Ewe Tegs.*

1st, No. 315.—MALCOLM KEMP, Leyton House, Rolvenden, Kent.
2nd, No. 314.—L. H. FINN, The Mall, Faversham, Kent.
3rd, No. 316.—CLIFFORD NICHOLSON, Willoughton Manor, Lincoln.

Class 569.—*Three Fleeces of Kent or Romney Marsh, excluding Rams and Ewe Tegs.*

1st & R.N. for "Merchants of the Staple of England" Special Prize, No. 322, 2nd, No. 321, & 3rd, No. 320.—L. H. FINN, The Mall, Faversham, Kent.

Class 570.—*Three Fleeces of Welsh Mountain.*

1st, No. 328, & 2nd, No. 329.—W. G. Roberts, Tregynan Ucha, Llanrhystyd, Aberystwyth.
3rd, No. 332.—Joe K. Williamson, Derwen Hall, Ruthin.

Class 571.—*Three Fleeces of Black Welsh Mountain.*

1st, No. 338, & 2nd, No. 339.—R. Ewart Owen, Tanlan Hall Home Farm, Prestatyn.
3rd, No. 333.—The Hon. Mrs. C. Behrens, Swinton Grange, Malton, Yorks.

BUTTER-MAKING COMPETITIONS.

Class 1.—*Open to Students who have attended a course at any Dairy School or Class in Staffordshire, Shropshire, Warwickshire and Worcestershire, and who have not won a First Prize at any Show.*

1st, £4. No. 22.—Miss B. Simpson, The Home Farm, Sandon, Stafford.
2nd, £3. No. 4.—Miss E. N. Davall, Manor Farm, Milwich, Stafford.
3rd, £2. No. 9.—Miss E. M. Gould, Moat Farm, White Ladies, Aston, Worcester.
4th, £1. No. 11.—Miss Phyllis Harper, Little Whitley Farm, Worcester.

R.N. No. 5.—Miss Edith E. Davies, Lower Eyton, Alberbury, Shrewsbury.
H.C. Nos. 1, 21. C. Nos. 8, 12.

Class 2.—*Open to Students who have received not less than one month's instruction at any Dairy School and who have not won a First or Second Prize at the R.A.S.E., London Dairy, Bath and West, Royal Counties, Three Counties, Royal Welsh, Royal Lancashire or Yorkshire Shows.*

Section A.

1st, £4. No. 34.—Miss Melba Eustice, Bezurrel, Gwinear, Hayle, Cornwall.
2nd, £3. No. 28.—Miss E. N. Davall, Manor Farm, Milwich, Stafford.
3rd, £2. No. 36.—Miss Margaret Grace Goodwin, Monmouthshire Institute of Agriculture, Usk.
4th, £1. No. 33.—Miss E. I. Eustice, Bezurrel, Gwinear, Hayle, Cornwall.

R.N. No. 29.—Miss Edith E. Davies, Lower Eyton, Alberbury, Shrewsbury
H.C. Nos. 35, 42. C. Nos. 32, 39.

Section B.

1st, £4. No. 52.—Miss M. Rogers, Arscott Hall, Pontesford, Shropshire.
2nd, £3. No. 45.—Miss W. Gittins, Lower Farm, Vennington, Westbury, Shropshire.
3rd, £2. No. 51.—Miss Louie Rogers, Stanley Villa, Stanwardine, Baschurch.
4th, £1. No. 59.—Miss Peggy West, Hay, Wadebridge, Cornwall.

R.N. No. 47.—Mrs. J. N. Prosser, Home Farm, Compton Verney, Warwickshire.
H.C. Nos. 48, 53. C. Nos. 56, 61.

Class 3.—*Open to those who have not won a First or Second Prize at any Show.*

1st, £4. No. 66.—Miss Melba Eustice, Bezurrel, Gwinear, Hayle, Cornwall.
2nd, £3. No. 65.—Miss Edytha H. Eustice, Tappard Farm, Gwinear, Hayle, Cornwall.
3rd, £2. No. 75.—Mrs. J. N. Prosser, Home Farm, Compton Verney, Warwickshire.
4th, £1. No. 67.—Miss Bessie Evans, Buckley, Pentre, Montford Bridge.

R.N. No. 77.—Miss Bessie Thornborrow, St. George's Hall, The University, Reading.
H.C. Nos. 70, 79. C. 68, 72.

Class 4.—*Open, except to Champions at the R.A.S.E., London Dairy, Bath and West, Royal Counties, Royal Lancashire or Yorkshire Shows.*

Section A.

1st, £5. No. 85.—Miss Dora E. Browning, The Storks, Ombersley, Droitwich.
2nd, £4. No. 104.—Miss P. Jones, Goodships Farm, Bromyard.
3rd, £3. No. 93.—Miss E. I. Eustice, Bezurrel, Gwinear, Hayle, Cornwall.
4th, £2. No. 88.—Miss Kathleen Curnow, Treveor, Tresillian, Truro.
5th, £1. No. 101.—Miss Nancy J. Heath, Monmouthshire Institute of Agriculture, Usk.

R.N. No. 92.—Miss Edytha H. Eustice, Tappard Farm, Gwinear, Hayle, Cornwall.
H.C. Nos. 89, 94. C. Nos. 90, 91.

Section B.

1st, £5. No. 120.—Miss Margaret E. Sandercock, Venterdon, Stoke Climsland, Cornwall.
2nd, £4. No. 110.—Miss Monica M. Olde, Clifton House, Boscastle, Cornwall.
3rd, £3. No. 112.—Miss P. Peer, Rectory Farm, Tibberton, Droitwich.
4th, £2. No. 126.—Miss Peggy West, Hay, Wadebridge, Cornwall.
5th, £1. No. 109.—Miss Gwendoline G. Olde, Clifton House, Boscastle, Cornwall.

R.N. No. 119.—Miss M. Rogers, Arscott Hall, Pontesford, Shropshire.
H.C. Nos. 107, 121. C. Nos. 113, 117.

Class 5.—*Inter-County Championships for teams of three, one of whom must be a Novice never having won a First or Second Prize up to the time of entry, the second member must not have won more than three First Prizes and must never have won any Championship, the third member may be a Champion at this or any Show.*

1st, £3 & Silver Medal each. No. 131.—MISS B. DIGGORY, Old Hall, Stoke Prior, Leominster; MISS DOROTHY POWELL, Maerdy, Lower Maescoed, Pontrilas; and MISS P. JONES, Goodships Farm, Bromyard. (Hereford.)
2nd, £2 each. No. 129.—MISS MELBA EUSTICE, Bezurrel, Gwinear, Hayle; MISS E. I. EUSTICE, Bezurrel; and MISS MONICA M. OLDE, Clifton House, Boscastle. (Cornwall.)
3rd, £1 each. No. 135.—MISS B. SIMPSON, The House Farm, Sandon, Stafford; MISS E. N. DAVALL, Manor Farm, Milwich; MISS DOROTHY ROE, Bradley Hall Farm, Stoke-on Trent. (Staffordshire.)
R.N. No. 136.—MISS E. M. GOULD, Moat Farm, White Ladies, Aston, Worcester; MISS DOROTHY SMITH, The Hermitage, Wadborough, Worcester; and MRS. SADIE I. PLATT, 172, Moseley Road, Bilston. (Worcestershire).

Class 6.—*Championship open to the First Prize Winners in Classes 1 to 5 or at any previous Royal Show, and to Champions of the London Dairy, Bath and West, Royal Counties, or any County Show.*

1st, £5 & Gold Medal. No. 150.—MISS MARGARET E. SANDERCOCK, Venterdon, Stoke Climsland, Cornwall.
2nd, £4. No. 145.—MISS FLOSSIE LEWIS, Court Farm, Llanmartin, Newport, Mon.
3rd, £3. No. 146.—MISS MONICA M. OLDE, Clifton House, Boscastle, Cornwall.
4th, £2. No. 141.—MISS NANCY HUTTON, 19, Chiltern Avenue, Higher Brunshaw, Burnley.
5th, £1. No. 143.—MISS MARIE JULIAN, Tredinnick Farm, Liskeard, Cornwall.

R.N. No. 147.—MISS P. PEER, Rectory Farm, Tibberton, Droitwich.
H.C. Nos. 142, 144, 148. C. Nos. 22, 34, 151.

FLOWER SHOW.

Class 1.—*Group of Miscellaneous Plants in and out of Bloom.*

1st, £40. No. 3.—J. L. SWANSON, Wergs Hall, Wergs, Wolverhampton.
2nd, £30. No. 1.—JAMES CYPHER & SONS, LTD., Queen's Road Nurseries, Cheltenham.
3rd, £15. No. 2.—T. M. PETCH, Highfield Nursery, Great Horton, Bradford.

Class 2.—*Collection of Delphiniums.*

1st, £8. No. 4.—BLACKMORE & LANGDON, Bath.

Class 3.—*Group of Tuberous Begonias in pots.*

1st, £20. No. 6.—BLACKMORE & LANGDON, Bath.
2nd, £15. No. 7.—H. WOOLMAN, Shirley, Birmingham.

Class 4.—*Group of Aquatic and Semi-Aquatic Plants.*

1st, £20. No. 11.—STEPHEN SIMS, Draycott, Derbyshire.
2nd, £15. No. 9.—GEORGE HOLLIS, Fearnlea Nursery, Carlton, Market Bosworth.
3rd, £10. No. 8.—HILLIER & SONS, West Hill Nurseries, Winchester.
4th, £5. No. 10.—M. PRICHARD & SONS, LTD., Riverslea Nurseries, Christchurch, Hants.

Class 5.—*Collection of Hardy Perennial Plants and Cut Blooms (Roses and Shrubs excluded).*

1st, £30. No. 13.—BEES, LTD., Sealand Nurseries, Chester.
2nd, £25. No. 18.—SUFFOLK SEED STORES, LTD., Woodbridge.
3rd, £20. No. 12.—WM. ARTINDALE & SON, LTD., Nether Green, Sheffield.
4th, £15. No. 16.—HARKNESS & SONS, Grange Nurseries, Leeming Bar, Northallerton.

Class 6.—*Best Collection of Tree Carnations.*

1st, £15 & Challenge Cup. No. 19.—C. ENGELMANN, LTD., Saffron Walden.
2nd, £10. No. 20.—STUART LOW CO., Bush Hill Park Nursery, Enfield, Middlesex.

Class 7.—*Collection of Cut Sprays of Border Carnations.*

1st, £15. No. 21.—HORACE LAKEMAN, Queensberry Nursery, Thornton Heath, Surrey.
2nd, £7. No. 22.—R. SMITH & CO., St. John's Nurseries, Worcester.

Class 8.—*Collection of Cut Roses.*

1st, £15. No. 25.—R. HARKNESS & CO., The Rose Gardens, Hitchin.
2nd, £10. No. 24.—C. GREGORY & SONS, LTD., Old Close Nurseries, Chilwell, Nottingham.
3rd, £7. No. 26.—THOMAS ROBINSON, Porchester Nurseries, Carlton, Nottingham.

WOLVERHAMPTON FLORAL FETE CLASSES.

"Express and Star" Perpetual Challenge Trophy. Nos. 34, 39 & 45.—R. HARKNESS & Co., The Rose Gardens, Hitchin.
R.N. Nos. 36, 41 & 47.—A. W. TOWNSEND, 9, Cross Street, Beeston, Notts.

Class 9.—*Rock Garden.*

1st, Challenge Trophy & £7. No. 32.—HAROLD MILLS (GARDENS), LTD., The Bhylls Nursery, Merry Hill, Wolverhampton.
2nd, £5. No. 31.—THOMAS KITCHEN & SON, Grove Lane Nurseries, Hale, Cheshire.
3rd, £3. No. 27.—ALPINE NURSERIES, LTD., Moorlands Road, West Moors, Wimborne, Dorset.
4th, £2. No. 29.—BROOKSIDE NURSERIES, LTD., Headington, Oxford.

Class 10.—*Thirty-six Blooms (distinct varieties).*

1st, £8. No. 34.—R. HARKNESS & Co., The Rose Gardens, Hitchin.
2nd, £4. No. 36.—A. W. TOWNSEND, 9, Cross Street, Beeston, Notts.
3rd, £2. No. 33.—MR. & MRS. J. GREGORY, Berrow Hill Nurseries, Franche, Kidderminster.

Class 11.—*Twelve new Roses (distinct varieties). Roses not in commerce before* 1930.

1st, Silver Medal & £3. No. 39.—R. HARKNESS & Co., The Rose Gardens, Hitchin.
2nd, £3. No. 41.—A. W. TOWNSEND, 9, Cross Street, Beeston, Notts.

Class 12.—*Eighteen Distinct Varieties of any Perpetual Flowering Roses.*

1st, £8. No. 47.—A. W. TOWNSEND, 9, Cross Street, Beeston, Notts.
2nd, £5. No. 45.—R. HARKNESS & Co., The Rose Gardens, Hitchin.
3rd, £3. No. 44.—MR. & MRS. J. GREGORY, Berrow Hill Nurseries, Franche, Kidderminster.

Class 13.—*Display of Sweet Peas (any varieties).*

1st, Challenge Trophy & £12. No. 50.—RALPH CHALLINOR, The Gardens, Lilleshall, Wellington, Shropshire.
2nd, £10. No. 51.—THOMAS JONES, JUNR., Bryn, Penylan, Ruabon.
3rd, £8. No. 49.—G. H. BROOKSHAW, Stock Lane, Hough, Crewe.

Class 14.—*Display of Cut Carnations.*

1st, Challenge Trophy & £15. No. 52.—F. DREW 52, Bridge Street, Walsall.

Exhibits not for Competition.

Large Gold Medals to :—

No. 53.—ALLWOOD BROS., Wivelsfield Nurseries, Haywards Heath. Carnations and Pinks.
No. 55.—BAKERS, Codsall, Wolverhampton. Delphiniums, etc.
No. 56.—BEES, LTD., Sealand Nurseries, Chester. Hardy Flowers, mostly Delphiniums.
No. 59.—FRANK CANT & Co., LTD., Braiswick Rose Gardens, Colchester. Cut Roses.
No. 60.—W. A. CONSTABLE, LTD., Southborough, Tunbridge Wells. Lilies.
No. 61.—CONWAYS, LTD., Halifax. Rock and Water Garden.
No. 73.—JOHN JEFFERIES & SON, LTD., Royal Nurseries, Cirencester. Rock and Shrub Garden.
No. 86.—JOHN PEED & SON, West Norwood, London, S.E.27. Stove and Greenhouse Plants.
No. 96.—STUDLEY COLLEGE, Warwickshire. Fruit and Vegetables.

Gold Medals to :—

No. 65.—ALEX. DICKSON & SONS, LTD., Hawlmark, Marks Tey, Essex. Roses.
No. 68.—LT.-COL. C. H. GREY, D.S.O., Hocker Edge Gardens, Cranbrook, Kent. Lilies and Rock Garden.
No. 80.—STUART LOW CO., Bush Hill Park, Enfield, Middlesex. Orchids.
No. 82.—HAROLD MILLS (GARDENS), LTD., The Bhylls Nursery, Merry Hill, Wolverhampton. Rock Garden.
No. 84.—NAPIERS, Stepswater Nurseries, Taunton. Carnations.
No. 91.—L. R. RUSSELL, LTD., Richmond Nurseries, Windlesham, Surrey. Water Lilies, Aquatic Shrubs, etc.
No. 97.—TOOGOOD & SONS, LTD., Southampton. Vegetables.
No. 100.—EDWARD WEBB & SONS (STOURBRIDGE), LTD., Wordsley, Stourbridge. Sweet Peas and Flowering Pot Plants.
No. 104.—WOOD & INGRAM, LTD., The Old Nurseries, Huntingdon. Roses.
No. 105.—BAKERS, Codsall, Wolverhampton. Floral Display.
No. 108.—W. LOWE & SON (NURSERIES), LTD., Beeston, Notts. Roses and Miniature Rock Garden.

Silver Gilt Medals to :—

No. 54.—ALPINE NURSERIES, LTD., Moorlands Road, West Moors, Wimborne. Alpine and Rock Plants.
No. 58.—BENJAMIN R. CANT & SONS, LTD., The Old Rose Gardens, Colchester. Roses.
No. 64.—DANIELS BROS., LTD., Norwich. Lilies, Gladioli, Perennials, etc.
No. 71.—HILLIER & SONS, West Hill Nurseries, Winchester. Plants and Cut Shrubs.
No. 76.—JOHN KLINKERT, Kew Topiary Nurseries, Stanmore Road, Richmond, Surrey. Topiary.
No. 78.—LAXTON BROS. (BEDFORD), LTD., Bedford. Strawberries and Roses.
No. 81.—MAXWELL & BEALE, LTD., Broadstone, Dorset. Miniature Rock and Heath Garden.
No. 88.—R. W. PROCTOR & SONS, The Nurseries, Chesterfield. Roses.
No. 95.—D. STEWART & SON, LTD., Ferndown Nurseries, Dorset. Bulbous and Herbaceous Flowers.
No. 101.—WHEATCROFT BROS., LTD., Ruddington, Nottingham. Roses.
No. 107.—HEWITT & CO., Banbury Road, Stratford-on-Avon. Dahlias.

Silver Medals to :—

No. 57.—BROOKSIDE NURSERIES, LTD., Headington, Oxford. Rock Plants.
No. 69.—W. G. HASKINS & SONS, Coy Pond Nurseries, Bournemouth, W. Clematis, Climbers and Wall Plants.
No. 74.—MISS M. JOLLY, 224, Wellington Road, Birchfield, Birmingham. Cacti and Succulents.
No. 75.—KELWAY & SON, LTD., Langport, Somerset. Pæonies and Delphiniums.
No. 77.—HORACE LAKEMAN, Queensberry Nursery, Thornton Heath, Surrey. Carnations.
No. 79.—G. F. LETTS & SONS, Hadleigh, Suffolk. Roses.
No. 87.—M. PRICHARD & SONS, LTD., Riverslea Nurseries, Christchurch, Hants. Herbaceous Plants.
No. 89.—F. RICH, Hindlip Nurseries, Worcester. Hardy Cut Flowers.
No. 92.—JOHN SCOTT & CO., The Royal Nurseries, Merriott. Shrubs, Herbaceous Flowers and Carnations.
No. 94.—J. F. SPENCER & SON, Hockley, Essex. Dahlias.
No. 99.—H. VEALE, Tong Castle Gardens, Shifnal. Delphiniums, etc.

FORESTRY.

No. 37.—Special Silver Gilt Medal for the best Collection of Exhibits to CAPT. G. C. WOLRYCHE-WHITMORE, Dudmaston, Bridgnorth.
No. 29.—R.N. to LORD BARNARD (Shropshire Estate), Uppington, Wellington, Shropshire.

The Prizes are First; Silver Medal; Second, Bronze Medal.

Class 1.—*Specimens of Oak, Elm, Ash, Spanish Chestnut, Sycamore and Beech Timber, or any of their varieties grown in Great Britain.*

1st, No. 1.—VISCOUNT and VISCOUNTESS SWINTON, Swinton, Masham, Yorks.

Class 2.—*Specimens of Larch, Silver Fir, Douglas, Spruce and Pine Timber.*

[NO AWARD.]

Class 3.—*Oak Field Gate for farm use. The gate must be made by the staff regularly employed on the Exhibitor's estate where the timber was grown.*

1st, No. 6.—CHATSWORTH ESTATES COMPANY, Estates Office, Chatsworth, Bakewell.
2nd, No. 7.—CAPT. G. C. WOLRYCHE-WHITMORE, Dudmaston, Bridgnorth.
R.N. No. 3.—LORD BARNARD (Raby Estate Yard), Estate Office, Uppington, Wellington, Shropshire.
H.C. No. 4.

Class 4.—*Field Gate for farm use, of any other home-grown wood or combination of home-grown woods.*

1st, No. 11.—H. A. BENYON, Estate Works, Englefield, Reading.
2nd, No. 12.—CHATSWORTH ESTATES COMPANY, Estate Office, Chatsworth, Bakewell.
R.N. No. 14.—CAPT. G. C. WOLRYCHE-WHITMORE, Dudmaston, Bridgnorth.
H.C. No. 10.

Class 5.—*Field Gate of Rent or Cleft Timber.*

[NO EXHIBIT.]

Class 6.—*Wicket or Hunting Gate (self-closing), manufactured from home-grown timber.*

1st, No. 20.—CAPT. G. C. WOLRYCHE-WHITMORE, Dudmaston, Bridgnorth.
2nd, No. 18.—CHATSWORTH ESTATES COMPANY, Estate Office, Chatsworth, Bakewell.
R.N. No. 16.—APLEY ESTATE COMPANY, 76, High Street, Bridgnorth.

Class 7.—*Tree Guard. The Guard must be made by the staff regularly employed on the Exhibitor's estate, where the timber was grown.*

1st, No. 21.—CHATSWORTH ESTATES COMPANY, Estate Office, Chatsworth, Bakewell.

Class 8.—*Field Fencing of home-grown wood and made in Great Britain.*

1st, No. 22.—CAPT. G. C. WOLRYCHE-WHITMORE, Dudmaston, Bridgnorth.

Class 9.—*Park and other Ornamental Fencing of home-grown wood, and made in Great Britain.*

1st, No. 24.—CAPT. G. C. WOLRYCHE-WHITMORE, Dudmaston, Bridgnorth.

Class 10.—*Forest Transplants and Seedlings.*

1st, No. 25.—THE ENGLISH FORESTRY ASSOCIATION, LTD., The Knowle Nurseries, Caversham Heights, Reading.

Non-Competitive Exhibits.

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LORD BARNARD (Shropshire Estate), Uppington, Wellington.
CAPT. G. C. WOLRYCHE-WHITMORE, Dudmaston, Bridgnorth.
CITY OF BIRMINGHAM PARKS COMMITTEE, 161, Corporation Street, Birmingham, 4.
LAND AGENTS' SOCIETY, 76, High Street, Bridgnorth.
TIMBER DEVELOPMENT ASSOCIATION, LTD., 69, Cannon Street, E.C.4.

Bronze Medals to :—

FISHER, SANDERS & CO., 43, High Street, Market Harborough.
MOULD & BLOOMER, Royal Square, Windermere.
R. A. LISTER & CO., LTD., Victoria Works, Dursley, Glos.
W. C. KIFLINGER, Marshall, Michigan, U.S.A.

GATE MAKING COMPETITION.

1st, £5, No. 1.—APLEY ESTATE CO., 76, High Street, Bridgnorth. (William Evans and Stephen Jones).
2nd, £3, No. 3.—LORD BARNARD'S RABY SHROPSHIRE ESTATE YARD, Uppington, Wellington, Shropshire. (Richard Childs and Thomas Pritchard).
3rd, £2, No. 2.—APLEY ESTATE CO., 76, High Street, Bridgnorth. (Edward Burton and Samuel Cole).
H.C. No. 5.

WOODLANDS, PLANTATIONS AND ESTATE NURSERIES COMPETITION.

Confined to Leicestershire, Warwickshire, Rutland and Northamptonshire.

The Royal English Forestry Society's Gold Medal for the Best Plantation.—TRUSTEES OF THE RAGLEY ESTATE for Ladies' Hill Plantation.

I.—*Where Hardwoods are intended as the final crop.*

Class (a).—*Planted from* 10 *to* 25 *years.*

[NO ENTRY.]

Class (b).—*Over* 25 *years of age.*

1st, Silver Medal.—BOUGHTON ESTATES, LTD, Kettering.

II.—*Where the final crop is intended to be Conifers, viz., Douglas Fir, Sitka Spruce, Norway Spruce, Japanese Larch, European Larch, Corsican Pine, Scots Fir, whether in single varieties or mixed.*

Class (a).—*Planted from* 10 *to* 20 *years.*

1st, Silver Medal.—TRUSTEES OF THE RAGLEY ESTATE, Alcester.
2nd, Bronze Medal.—THE STANTON IRONWORKS CO., LTD., Nottingham.

Class (b).—*Over* 20 *years of age.*

1st, Silver Medal.—MRS. E. M. CONANT, Bulwick Park, Peterborough.
2nd, Bronze Medal —THE NOSELEY ESTATES CO. (Sir Arthur Hazlerigg, Bt.), Noseley Hall Leicester.

III.—*Where the intention is to have a Mixed Wood of Hardwoods and Conifers.*

Class (a).—*Planted from* 10 *to* 20 *years.*

[NO AWARD.]

Class (b).—*Over* 20 *years of age.*

1st, Silver Medal.—BOUGHTON ESTATES, LTD, Kettering.
2nd, Bronze Medal.—THE NOSELEY ESTATES CO. (Sir Arthur Hazlerigg, Bt.), Noseley Hall, Leicester.

IV.—*Plantations of not less than one acre, consisting of any Conifer not specified in Class II, planted not less than* 5 *years.*

[NO AWARD.]

V.—*For the best managed Coppice or Coppice with Standards, to include not less than three "falls" of different age and each of which is not less than one acre in extent.*

[NO ENTRY.]

VI.—*For the best managed Estate Nursery.*

[NO AWARD.]

VII.—*For the best managed Woodlands on an Estate of not less than* 1,000 *acres; the Judges to take into account examples of systematic management for the production of timber, as well as ornamental planting, planting for sporting purposes, and improvement of residential amenities.*

1st, Special Silver Gilt Medal.—TRUSTEES OF THE RAGLEY ESTATE, Alcester.

YOUNG FARMERS' CLUB SECTION.

Classes open only to Members of the National Federation of Young Farmers' Clubs in Cheshire, Derbyshire, Lancashire, Leicestershire, Nottinghamshire, Shropshire, Staffordshire, Warwickshire and Worcestershire.

No. 30.—The N.F.Y.F.C. Champion Prize and Mr. U. Roland Burke's Champion Cup for the best Dairy Calf to JOHN ROWLAND with Outseats Tellurias Gem 3rd.
No. 23.—R.N. MISS E. SHIRLEY.
No. 109.—The N.F.Y.F.C. Champion Prize and Mr. U. Roland Burke's Champion Cup for the best Beef Calf to MARY PALMER with Simon.
No. 118.—R.N. A. BOSTOCK.

Class 1.—*Dairy Heifer, any breed or cross, born on or between January* 1 *and March* 31, 1936.

1st, 40s. No. 4.—KEITH HAINE, Kingstone Farm, Long Compton, Rose. (Shorthorn.)
2nd, 30s. No. 6.—PHYLLIS HAINE, Tower Farm, Little Wolford, Jenny. (Shorthorn.)
3rd, 20s. No. 9.—EDWARD HIGGINSON, Luddington Dairy, Stratford-on-Avon. (Shorthorn.)
4th, 17s. 6d. No. 10.—BETTY STEELE, Staple Hill Farm, Wellesbourne, Warwick. (Shorthorn.)
5th, 15s. No. 3.—JEAN HAINE, Kingstone Farm, Long Compton, Ruby. (Shorthorn.)
6th, 12s. 6d. No. 7.—WILLIAM HERITAGE, Church Farm, Oxhill, Warwick, Molly. (Shorthorn.)
7th, 5s. No. 8.—PHYLLIS HENSON, Lower Clopton Farm, Stratford-on-Avon, Lucy. (Shorthorn.)
R.N. No. 1.—DOROTHY ARCHER, Sambourne, Astwood Bank, Redditch, Day-Dream (Shorthorn.)

Class 2.—*Dairy Heifer, any breed or cross, born on or between April* 1 *and June* 30, 1936.

1st, 40s. No. 28.—MISS E. SHIRLEY, New House Farm, Weston, Leamington Spa. (Shorthorn.)
2nd, 30s. No. 14.—MISS M. BOSTOCK, The Oaks, Rouncil Lane, Kenilworth. (Shorthorn.)
3rd, 20s. No. 22.—MISS M. PARRISS, Glebe Farm, Cubbington, Leamington Spa. (Shorthorn.)

4th, 17s. 6d. No. 21.—MISS J. PARRISS, Glebe Farm, Cubbington, Leamington Spa. (Shorthorn.)
5th, 15s. No. 17.—MISS M. EVANS, Bunker's Hill, Offchurch, Leamington Spa. (Shorthorn.)
6th, 12s. 6d. No. 19.—BETH HUNT, Kites Nest Farm, Beausale, Warwick, Seven. (Shorthorn.)
7th, 5s. No. 24.—MISS J. WHITEHOUSE, Walworth Farm, Bishop's Itchington, Leamington Spa. (Shorthorn.)

Class 3.—*Dairy Heifer, any breed or cross, born on or after July* 1, 1936.

1st, 40s. No. 30.—JOHN ROWLAND, Callow Hall, Kirk Ireton, Outseats Tellurias Gem 3rd. (Shorthorn.)
2nd, 35s. No. 44.—FRANK FARE, Stanley Farm, Treales, Preston, Ruby. (Shorthorn.)
3rd, 30s. No. 49.—RENE KIRKHAM, Harbour Farm, Salwick, Preston, Marina. (Shorthorn.)
4th, 25s. No. 46.—HARRY FARE, Stanley Farm, Preston, Daisy. (Shorthorn.)
5th, 22s. 6d. No. 34.—HARRY WALKER, Two Dales Farm, Annesley, Notts., Joan. (Shorthorn.)
6th, 20s. No. 65.—JAMES MORLEY, Pop Hall, Catforth, Preston, Peggy. (Shorthorn.)
7th, 17s. 6d. No. 35.—T. COWELL, Yew Tree Farm, Goosnargh, Tulip. (Shorthorn.)
8th, 15s. No. 42.—MARY BRAITHWAITE, Newton Hall, Newton, Preston, Rose. (Shorthorn.)
9th, 12s. 6d. No. 40.—WYNN PEARSON, Whitehead Farm, Goosnargh, Princess. (Shorthorn.)
10th, 10s. No. 52.—GRACE PARKINSON, South View, Treales, Preston, Grace. (Shorthorn.)
11th, 7s. 6d. No. 54.—T. SANDERSON, Moorside, Treales, Preston, Betty. (Shorthorn.)
12th, 5s. No. 85.—JAMES WINDRIDGE, Nuthurst Heath Farm, Astley, Nuneaton, Daisy. (Shorthorn.)

R.N. No. 45.—GERTRUDE FARE, Yew Tree Farm, Salwick, Preston, Alice. (Shorthorn.)
H.C. Nos. 29, 56, 73, 77, 78.

Class 4.—*Club Team of Three Dairy Calves.*

1st, 40s. No. 106.—WARWICK & DISTRICT YOUNG FARMERS' CLUB.
2nd, 30s. No. 91.—KIRKHAM YOUNG FARMERS' CLUB.
3rd, 20s. No. 86.—DERBY YOUNG FARMERS' CLUB.
4th, 15s. No. 107.—WARWICK & DISTRICT YOUNG FARMERS' CLUB.
5th, 10s. No. 108.—WARWICK & DISTRICT YOUNG FARMERS' CLUB.
6th, 5s. No. 103.—SHIPSTON-ON-STOUR YOUNG FARMERS' CLUB.

R.N. No. 92.—KIRKHAM YOUNG FARMERS' CLUB.

Class 5.—*Beef Steer, any breed or cross, born on or between January* 1 *and June* 30, 1936.

1st, 40s. No. 109.—MARY PALMER, Lower Spernal, Studley, Simon. Hereford-Shorthorn cross.)
2nd, 30s. No. 118.—A. BOSTOCK, The Oaks, Rouncil Lane, Kenilworth, (Shorthorn.)
3rd, 20s. No. 110.—WILLIAM PALMER, Lower Spernal, Studley, Bill. (Hereford-Shorthorn cross.)
4th, 15s. No. 115.—JOHN HENSON, Lower Clopton Farm, Stratford-on-Avon, Clopton Lad. (Hereford-Shorthorn cross.)
5th, 10s. No. 114.—T. RAYMOND MILLS, 218, Tile Cross Road, Marston Green, Birmingham, Bill. (Hereford-Shorthorn cross.)
6th, 5s. No. 111.—E. SOLLIS, Mappleboro' Green, Redditch, Bill. (Hereford-Shorthorn cross.)

H.C. No. 116. C. No. 117.

Class 6.—*Beef Heifer, any breed or cross, born on or between January* 1 *and June* 30, 1936.

1st, 40s. No. 121.—THOMAS EVANS, Bunkers Hill, Offchurch, Leamington Spa. (Hereford-Shorthorn cross.)
2nd, 30s. No. 128.—BARBARA JONES, The Home Farm, Hampton-in-Arden, Peggy. (Hereford-Shorthorn cross.)
3rd, 20s. No. 131.—GEORGE STEELE, Netherton Hall, Elmley Castle, Pershore. (Hereford cross.)
4th, 15s. No. 125.—WM. E. GREEN, Holt Farm, Studley, Flora. (Hereford-Shorthorn cross.)
5th, 10s. No. 130.—CLAUDE HOGG, Cold Comfort Farm, Clifford Chambers, Stratford-on Avon, Bell. (Hereford-Shorthorn cross.)
6th, 5s. No. 124.—LEONARD N. GREEN, Common Farm, Mappleboro' Green, Studley Strawberry. (Hereford-Shorthorn cross.)

H.C. 132. C. 127.

Class 7.—*Beef Heifer or Steer, any breed or cross, born on or after July 1, 1936.*

1st, 40s. No. 133.—D. R. HEMUS, Bullock End Farm, Drayton Bassett, **George.** (Hereford-Shorthorn cross.)
2nd, 20s. No. 137.—S. SOLLIS, Mappleboro' Green, Redditch, (Hereford-Shorthorn cross.)
3rd, 15s. No. 136.—NOEL GREEN, Mappleboro', Redditch, (Hereford-Shorthorn cross.)
4th, 5s. No. 135.—DOROTHY ARCHER, Sambourne, Astwood Bank, Redditch, (Hereford. (Shorthorn cross.)

R.N. No. 134.—C. PHIZACKLEA, Church Farm, Seckington, **Jumbo.** (Hereford-Shorthorn cross.)

Class 8.—*Club Team of Three Beef Calves.**

1st, 40s. No. 138.—ALCESTER YOUNG FARMERS' CLUB.
2nd, 30s. No. 143.—WARWICK & DISTRICT YOUNG FARMERS' CLUB.
3rd, 20s. No. 142.—STRATFORD-ON-AVON YOUNG FARMERS' CLUB.
4th, 15s. No. 139.—ALCESTER YOUNG FARMERS' CLUB.
5th, 10s. No. 140.—HAMPTON-IN-ARDEN YOUNG FARMERS' CLUB.
6th, 5s. No. 141.—HAMPTON-IN-ARDEN YOUNG FARMERS' CLUB.

IMPLEMENTS.

Silver Medals for New Implements.

No. 659.—JOHN WILDER, LTD., The Cattle Market, Reading, for Cutlift Elevator.

No. 908.—R. H. NEAL & CO., LTD., Plant House, Ealing, London, W.5. for Drainage Trench Digger.

No. 919.—HALLIDAY BOILERS LTD., Saxon Road, Selhurst London, S.E.25. for Sterilizing Equipment.

*Prizes offered by the National Federation of Young Farmers' Clubs.

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Agricultural Economics Research Institute. The Agricultural Register 1936–37. A record of Agricultural Legislation, Organization, Supplies and Prices in the past year. Oxford, 1937 . . . . *Institute*

——— Grass Drying. A Study of Production Costs in 1936. By R. N. Dixey and R. P. Askew . . . . . *Institute*

——— Egg Prices. A Study of the Factors affecting Prices and Production. By O. J. Beilby . . . . . *Institute*

——— Mechanized Corn Growing. A Record of Three Years' Experience, 1934–36. By A. Bridges and E. P. Weeks *Institute*

——— Milk Consumption. By K. A. H. Murray . *Institute*

——— Milk Marketing before and after Organization. A Study in Central Somerset. By B. L. Smith and H. Whitley . . . . *Institute*

——— Tuberculin-Tested Milk. A Study of Re-organization for its Production. By R. N. Dixey. Oxford, 1937 . *Institute*

Agricultural Research Council. Grass Drying. A Report prepared for the Committee on the Preservation of Grass and other Fodder Crops. By E. J. Roberts, M.A., B.Sc. London, 1937 . . . . *Council*

Armstrong College, Department of Agriculture. An Agricultural Survey of the Northern Province. By J. A. Hanley, A. L. Boyd and W. Williamson, 1936 . . . . *College*

Armstrong, S. F. British Grasses and their Employment in Agriculture (3rd ed.). Cambridge, 1937 . . . *Purchased*

British Museum. African Bees of the genera *Ceratina*, *Halictus*, and *Megachile*. By Prof. T. D. A. Cockerell. London, 1937 *Museum Trustees*

British Standards Institution. B.S. Apparatus and Methods for the Determination of the percentage of Fat in Milk and Milk Products by the Babcock Method. Part I.—Apparatus; Part 2—Methods. No. 755, October, 1937 . . *Institution*

Cadbury Bros. Ltd. Vitamin D in Cacao Shell. Reports on Recent Researches, including Investigations into its Use as an Accessory Fodder. Technical Series 23–37. . . . *Company*

Canada Year Book, 1937 . . . . . *High Commissioner*

College of Estate Management. Travelling Scholars' Reports:
No. 3. A Survey of Sheep Management in Great Britain. By R. Owen Wood, B.Sc.
No. 4. The Improvement of Bacon Pigs by Co-operative Methods. An exposition of some aspects of Co-operation in relation to Pig Husbandry in Denmark and Sweden. By G. R. H. Bishop, B.Sc.
No. 5. Observations on American Dairy Husbandry. By A. S. Foot. M.Sc. (*Printed for private circulation.*) *College*

"Denmark, 1937." Copenhagen, 1937 . . *Danish Government*

DELEGATIONS FOR THE PROMOTION OF ECONOMIC CO-OPERATION BETWEEN THE NORTHERN COUNTRIES. Northern Countries in World Economy. Copenhagen, 1937 ... *Danish Legation*

ELLIS, J. C. B. The Feeding of Farm Live Stock. London, 1937 . . . . *Publishers*

FOOD COUNCIL. Report on Costs and Profits of Retail Milk Distribution in Great Britain. London, 1937 . . . *Purchased*

HANNAH DAIRY RESEARCH INSTITUTE. Annual Report for year ending 31st March, 1937 . . . . *Institution*

FRASER, ALLAN. Sheep Farming. London, 1937 . . *Publishers*

GUSTAFSON, A. F. Conservation of the Soil. New York and London, 1937 . . . . *Publishers*

HALL, SIR A. DANIEL. The Feeding of Crops and Stock. 2nd ed. in three parts. Part I.—The Plant; Part II.—Soils and Fertilizers; Part III.—The Nutrition of Animals and Man. London, 1937. . . . . *Publisher*

HARVEY, W. CLUNIE, and H. HILL. Milk Products. London, 1937 . . . . *Publishers*

HILL, A. F. Economic Botany. A text book of useful Plants and Plant Products. New York and London, 1937 . . *Publishers*

HOARE, A. H. Vegetable Crops for Market. London, 1937 *Publishers*

HORACE PLUNKET FOUNDATION. Year Book of Agricultural Co-operation. London, 1937 . . . . . . *Purchased*

IMPERIAL ECONOMIC COMMITTEE.
Dairy Produce Supplies, 1936.
Fruit Supplies, 1936.
Wool Production and Trade, 1936–37.
World Consumption of Wool, 1936.

Summaries of Figures of Production and Trade relating to :—
Dairy Produce;
Fruit;
Grain Crops;
Industrial Fibres;
Meat;
Vegetable Oils and Oil Seeds.
Thirty-first Report—Tobacco. 1937 . . . . *Purchased*

JEFFCOCK, W. P. Agricultural Politics, 1915–35. Ipswich, 1937 . . . . *Purchased*

JEKYLL, GERTRUDE. A Gardener's Testament. A selection of articles and notes. Edited by F. Jekyll and G. C. Taylor. London, 1937 . . . . *Publishers*

JOURNAL OF AGRICULTURAL SCIENCE. Vol. XXVII, 1937 *Purchased*

KNOWLES, FRANK, and J. E. WATKIN. A Practical Course in Agricultural Chemistry. London, 1937 . . . *Publishers*

LAND SETTLEMENT ASSOCIATION. Second Annual Report, for 1936 . . . . *Association*

LONDON UNIVERSITY. Centenary Commemorative Volume, June 27th—July 3rd, 1936 . . . . *University*

MCGRATH, RAYMOND, and A. C. FROST. Glass in Architecture and Decoration. London, 1937.
Pilkington Bros. Ltd., and Chance Bros. & Co. Ltd.

MECHANIZED FARMING, The Second Conference on, Oxford, January 5th–8th, 1937. Programme and Papers; Report of Discussions . . . . *Prof. Watson*

MILLER, WM. C., and E. D. S. ROBERTSON. Practical Animal Husbandry (2nd ed., rev. and enl.). Edinburgh and London, 1937 . . . . *Purchased*

MINISTRY OF AGRICULTURE AND FISHERIES. Bulletins: No. 31., The Handling of Milk and Milk Products; No. 36, Manures and Manuring; No. 95, Strawberries; No. 98, The Soils of Cambridgeshire; No. 104, Cider Apple Production, 1937 *Ministry*

——— Fifth Progress Report of the FOOT AND MOUTH DISEASE RESEARCH COMMITTEE, 1937 . . . . . . *Purchased*

——— Mechanization of Agriculture. Fifth Selected Bibliography (References in the Ministry's Library). Fol. typescript. January, 1937 . . . . *Ministry*

——— Third Bibliography of Literature on Agricultural Meteorology. January, 1937 . . . . . . *Ministry*

MINISTRY OF AGRICULTURE AND FISHERIES AND DEPARTMENT OF AGRICULTURE FOR SCOTLAND. Register of Attested Herds, July 31st, 1937 . . . . *Ministry*

MINISTRY OF AGRICULTURE AND FISHERIES and other Departments. Reports on the Work of Agricultural Research Institutes and on certain other investigations in the United Kingdom, 1934–35. 1937 . . . . *Purchased*

NATIONAL INSTITUTE FOR RESEARCH IN DAIRYING. Twenty-fifth Anniversary Review by the Staff of the Institute. 1937 *Institute*

NATIONAL PIG BREEDERS' ASSOCIATION. Pig Breeders' Annual, Vol. 17, 1937–38 . . . . *Association*

NEW ZEALAND DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH. Bulletin No. 50 (Dairy Research Institute Publication No. 72). The Cheese Yielding Capacity of Milk and its relation to the Method of Payment for Milk for Cheese-making. Wellington, 1936 . . . *Department*

PESEL, L. F., and R. E. S. SPENDER. Iris Culture for Amateurs. London, 1937 . . . . *Country Life*

ROTHAMSTED EXPERIMENTAL STATION. Report for 1936.

———Rothamsted Memoirs on Agricultural Science, Vol. XX, 1935-36 . . . . *Director*

ROYAL ENGLISH FORESTRY SOCIETY. Estate Woodlands (booklet, 1937) . . . . *Society*

SCOTLAND, DEPARTMENT OF AGRICULTURE. Seventh Report on the Profitableness of Farming in Scotland, 1934–35. Edinburgh, 1936 . . . . *Department*

——— Eighth Report on the Profitableness of Farming in Scotland, 1935–36. Edinburgh, 1937 . . . *Department*

SMITHSONIAN INSTITUTION. Annual Report of the Board of Regents, for the year ending June 30th, 1936 . . *Institution*

SEALE HAYNE AGRICULTURAL COLLEGE, Department of Economics. Some Economic Considerations of the Pig Industry in Devon and Cornwall. By S. T. Morris, M.Sc. Fol. typescript. September, 1937 . . . . *College*

SHORTHORN SOCIETY. Shorthorn Breeders' Review, 1936 . *Society*

——— Pictorial Record, 1936 . . . . . . *Society*

SMITH, A. D. BUCHANAN, O. J. ROBISON and D. M. BRYANT. The Genetics of the Pig (Reprint from *Bibliographica Genetica*). 1936 . . . . *Purchased*

SMITH, F. Principles of Agriculture for Bengal. Calcutta, 1911 *Author's Family*

SMITH, HARRIS PEARSON. Farm Machinery and Equipment (2nd ed.). New York and London, 1937 . . . . . *Publishers*

SOUTH EASTERN AGRICULTURAL COLLEGE, Department of Economics. Report No. XXV. Investigation into Farming Costs of Production and Financial Results : XVIII.—Financial Problems of Sheep Husbandry. By Jas. Wyllie . *College*

——— The Educational Value of Farm Accounts. By Jas. Wyllie. Paper read before Agricultural Organizers' Conference, Oxford, July, 1937 . . . . . . *College*

STAPLEDON, PROF. R. G. The Hill Lands of Britain. Development or Decay ? London, 1937 . . . . . . *Purchased*

STATUTES. Public General Acts and Measures : 1 Edward VIII and 1 George VI, 1936–37. London, 1937 . . *Purchased*

SURVEY OF THE AGRICULTURAL AND WASTE LANDS OF WALES. Edited for the Cahn Hill Improvement Scheme by R. G. Stapledon, C.B.E. London, 1936 . . . . . *Purchased*

THOMSEN, F. L. Agricultural Prices. New York and London, 1936 . . . . *Publishers*

UNITED STATES DEPARTMENT OF AGRICULTURE. Agricultural Statistics, 1937 (presenting information formerly published in the Statistical Section of the Year Book of Agriculture). Washington, 1937 . . . . *Department*

——— Year Book of Agriculture, 1937 . . . *Department*

WATSON, PROF. J. A. SCOTT, and MRS. MAY ELLIOTT HOBBS. Great Farmers, London, 1937 . . . . . *Prof. Watson*

WATSON, PROF. J. A. SCOTT, and JAMES A. MORE. Agriculture : The Science and Practice of British Farming (4th ed. rev. and enl.). Edinburgh and London, 1937 . *Prof. Watson*

WEST OF SCOTLAND AGRICULTURAL COLLEGE. Boron in Agriculture. By R. W. G. Dennis and D. G. O'Brien. Research Bulletin No. 5. September, 1937 . . *Boron Agric. Bureau*

PARLIAMENTARY PAPERS, ETC.

DEVELOPMENT COMMISSION. Twenty-sixth Report of the Commissioners, being for the year ended the 31st March, 1936.

MINISTRY OF AGRICULTURE AND FISHERIES. Agricultural Statistics, 1935, and 1936, Part I.

Report of Proceedings under the Diseases of Animals Acts for the year 1936.

Report of Operations and Proceedings under the Land Drainage Act, 1930. From the passing of that Act (Aug. 1st, 1930) to March 31st, 1937.

Report of Proceedings under the Agricultural Wages (Regulation) Act, 1924, for the year ended September 30th, 1936.

GOVERNMENT WHITE PAPER. Milk Policy. Cmd. 5533, 1937.

HOUSE OF LORDS SELECT COMMITTEE ON AGRICULTURE (DAMAGE BY RABBITS). Report, together with the Proceedings of the Committee and Minutes of Evidence, 1937.

FORESTRY COMMISSION. 17th Annual Report for year ending September 30th, 1936. 1937.

MINISTRY OF TRANSPORT. Report on the Administration of the Road Fund for the year 1936–37.

DEPARTMENT OF AGRICULTURE FOR SCOTLAND. Agricultural Statistics, 1935.

——— Twenty-fifth Report, being for the year ended 31st December, 1936. Cmd. 5410, 1937.

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